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Industrial Waste and Pretreatment in the Buffalo Municipal System

McPhee, Smith, Rosenstein Engineers, Buffalo, N Y

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INDUSTRIAL WASTE AND PRETREATMENT IN THE BUFFALO MUNICIPAL SYSTEM

Grant No. R803005

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ABSTRACT

The requirements and effects of combined treatment of industrial and domestic wastewater were investigated for the Buffalo Sewer Authority's sewerage system. The objectives of the study were: 1) to establish an industrial waste control program; 2) to establish an equitable cost recovery and user charge system; and 3) to evaluate the effects of the local, state and federal requirements on the industrial users of Buffalo's sewerage system.

A comprehensive industrial waste survey was performed to obtain the required background information on industrial discharges. This was accomplished in three phases: Phase I identified the industrial users and their types of discharges (ie. domestic and process); Phase II determined the quality and quantity of wastewater from 85 of the larger industries in Buffalo; and Phase III determined the quality and quantity of wastewater from an additional 79 industries.

Material balances were performed on Buffalo's sewerage system in order to define the volume and waste characteristics of each class of user (residential, industrial, inflow and infiltration). This data is essential in developing equitable cost recovery and user charge programs and to properly establish incompatible pollutants discharge limits.

Based upon the findings of the Industrial Waste Survey and the material balances, an industrial waste control program was developed. Buffalo's program included revised sewer use regulations coupled with a permit system and monitoring program.

A combination of ad valorem tax and wastewater service charges, based on waste strength and volume were used to recover the cost of treatment. In addition, for industries discharging high strength wastes, surcharges were used to recover the increased cost of treatment incurred. An economic evaluation of these programs on the industrial users was then performed. Evaluated were: the economics of reducing incompatible pollutant loadings (pretreatment vs joint treatment, and pretreatment vs dilution) and the economics of reducing compatible pollutant loadings (surcharge vs dilution and surcharge vs pretreatment).

A 95,000 liter/day activated sludge pilot study was conducted to evaluate the effects that industrial users will have on the treatment processes. The metal concentrations in the effluent and waste sludges were defined and the potential of credits for the incidental removals of metals was explored.

In the study area, three potential options were found for the disposal of the sludge generated by Buffalo sewage treatment plant: soil conditioning, landfill, and co-disposal with refuse. The industrial contributions of metals to the waste treatment plant could affect the use of the first two options. However, the enforcement of Buffalo's Sewer Use Regulations will result in a sufficient reduction of metal loadings to minimize the sludge disposal problems due to its metal content.

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SECTION 1

INTRODUCTION

PURPOSE AND SCOPE

Buffalo, like many other industrialized communities, treats both industrial and residential wastewaters at its sewage treatment plant. While combined treatment can be mutually beneficial to both the users and the treatment agency, it can also result in the need for additional planning and administration to operate the facility. In addition, the publicly owned treatment works is subjected to more stringent discharge criteria. A publicly owned treatment works, which accepts industrial waste, must 1) define the cost of treatment then equitably proportionate it to its users; 2) define what is acceptable for discharge to its sewerage system then enforce it; and 3) insure that the methods used in items 1 and 2 are in compliance with its National Pollutant Discharge Elimination System (NPDES) permit and EPA's requirements resulting from the acceptance of federal aid for the facility's construction.

In concert with these requirements, the objectives of this study were: 1) to establish an industrial waste control program, including the revision of Buffalo's existing sewer use regulations; 2) to establish an equitable cost recovery and user charge system; and 3) to evaluate the effects of the local, state and federal requirements on the industrial users of Buffalo's sewerage system.

The first task was to obtain a data base from which these programs could be developed. Extensive information relative to industrial discharges was obtained through a comprehensive industrial waste survey. In addition, analyses were performed on composite samples from outside sewer districts tributary to the system and on a residential section of the city to determine their contributions. The treatment plant's influent waste characteristics were determined and the effluent and sludge characteristics were projected for Buffalo's secondary treatment plant, from data obtained during the pilot study on the Buffalo Sewer Authority's new treatment facility which is slated for completion in 1980.

An industrial waste control program was developed which included the revision of the existing sewer use regulations and the adoption of a permit and monitoring program to enforce the regulations. In establishing this program, consideration was given to the various alternatives for controlling industrial discharges and to the legal authority necessary to enforce the control measures. In addition, the use of the proposed Federal Standards of performance and pretreatment standards for industrial discharges into publicly owned treatment works was evaluated for use in the Buffalo Sewer Use Regulations.

The use of ad valorem tax and wastewater service charges, based on waste strength and volume, were evaluated to establish an equitable cost recovery and user charge system for Buffalo. In addition, the economics for reducing the compatible and incompatible pollutants loadings from industry were evaluated.

The joint treatment of industrial and residential wastewater can offer both advantages and disadvantages to a publicly owned treatment works. As part of this study, an investigation was made into the effect that various industrial discharges have on the overall system. Three of the effects given special consideration in the study were: 1) the anticipated reduction in pollutants loading due to the enforcement of Buffalo's Sewer Use Regulations; 2) the possibility of granting credits to industrial users based on the incidental removals of incompatible pollutants at Buffalo's waste treatment plant; and 3) the effect that the inclusion of industrial waste has on Buffalo's sludge disposal options.

THE BUFFALO SEWER AUTHORITY SYSTEM

The City of Buffalo is located in northwestern New York State, (Erie County) encompassing 42.7 square miles along the northern end of Lake Erie and the Niagara River. The city and surrounding area has a gentle slope with a maximum elevation of 698.95 ft. in the northeast and a minimum of 571.84 ft. at lake level.

The city is approximately 89.5 percent developed according to the 1963 Land Use Survey. The majority of the undeveloped area is comprised of inland waterways and vacant land.

The Great Lake's Water Basin, in particular Lake Erie and the Niagara River, is used by Buffalo and the surrounding communities as both a source of drinking water and wastewater disposal. Tributary to the Basin and flowing through Buffalo are three other waterways which are used to convey wastewater: the Buffalo River, the Cazenovia Creek and the Scajaquada Creek.

The population of the City of Buffalo has decreased from its peak of almost 600,000 during the 1950's to its present level of 460,000. Population projections by various state and local agencies show Buffalo's population to remain essentially unchanged over the next thirty years. On the other hand, the population of the metropolitan area has followed the national trend by increasing to its present level of 1.3 million persons. Only a slight increase is projected for the future.

Buffalo and its surrounding area can be considered to be highly industrialized. The type of industries range from steel mills and oil refineries to flour mills and dairy processors. As can be expected, the waste generated varies widely in volume and complexity. While generally the larger industries treat and discharge directly to waterways, substantial industrial wastewater is discharged to the Buffalo Sewer Authority's system for conveyance and treatment.

In 1935, the Buffalo Sewer Authority was formed to manage and regulate the City's wastewater disposal efforts. Soon thereafter, in July of 1938, the Bird Island Treatment Plant went on stream. At the present time, a secondary treatment plant with facilities for the removal of phosphorus is under construction. Its completion date is set for early 1980. The present flow averages 643 megaliters/day (170 MGD) and the design flow for the new plant is 681 megaliter/day (180 MGD).

Erie County undertook a county-wide sewerage study to develop a master plan for the construction of sanitary sewage treatment and collection systems. A sub-regional plan was adopted whereby adjacent sewer districts are combined for treatment at one plant. Under this plan the Buffalo Sewer Authority will treat wastewater from certain outside sewer districts. At the present time, the Authority is treating approximately 113.6 megaliters per day from communities outside of Buffalo. The projected plan has some of these communities dropping out of the Buffalo system as new plants are constructed, and others joining the system once their interceptor sewers are built.

An average of 75.7 megaliters per day of extraneous flow enters the Authority's system via the Scajaquada Creek. The creek is a natural waterway flowing westward through the cityand terminating at the Niagara River. Originally, the creek received only overflows during wet weather, however, direct discharges were gradually made as storm relief projects were implemented. The Authority enclosed the creek at the city line and now utilizes it as an integral part of its sewer system. The Buffalo Sewer Authority presently has a project underway and others on the drawing board, to eliminate this source of extraneous flow.

The collection system of the Buffalo Sewer Authority is largely combined sewers. The most recent comprehensive sewerage study,[1] found that 96% of the city's sewers were of the combined type. In addition, 60% of the sewers were constructed prior to 1910 with only 8% installed since 1941. Many of the sewers were installed at a minimum grade and as a result, solids tend to settle out in them during dry weather.

As can be expected, after considering the age of the sewers, the area's relatively flat topography, and the high water table, infiltration is a problem. The Authority's consultants have estimated that ground water infiltration city-wide, to average 1380 liters per hectare per day.

Ground water infiltration is not the only source of extraneous flow in the Authority's system. River water, on occasion, enters the system through overflows which either have no backwater gates or through gates which are jammed open by debris. The city presently has seventy outfalls to open waterways. The average yearly inflow from these overflows is approximately 4.2 megaliters per day.

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[1] Leonard S. Wegman Co., Inc. Comprehensive Sewer Study for the Buffalo Sewer Authority. Buffalo, New York. 1973. p.IV 1 - IV 22.

SECTION 2

CONCLUSIONS

INDUSTRIAL WASTE SURVEY

1. To satisfy the federal construction grant and National Pollutant Discharge Elimination System permit's requirement, an industrialized community must perform an industrial waste survey.

2. The industrial waste control, cost recovery and user charge programs as well as the industrial waste survey itself, can be facilitated by conducting the industrial waste survey in phases. In the Buffalo survey, the first phase was identification of all industrial users, the second phase was sampling of the most significant industrial contributors, and the third phase was follow-up sampling of the remaining significant industries.

3. Industries using the municipal system can be identified by using existing sewer files, city and state industrial directories, tax and water records, and telephone yellow pages.

4. Industrial waste questionnaires were sent out to obtain background data. However, 90% of these had to be followed up by phone calls or scheduled plant visits to obtain questionnaires which were accurately completed.

5. An effective method for improving the efficiency in obtaining reliable data from the questionnaires, particularly those sent to non-manufacturing establishments, was to include a cover letter with the questionnaire explaining how the questionnaire relates to specific types of establishments. The letter would direct their attention to significant areas of concern thus aiding in the completion of the questionnaire.

6. The identification phase of the industrial waste survey identified 1020 of the 1466 industries as being "dry" (no process water) and an additional 26 as being either out of business or synonymical with other firms.

7. A public relations program is an important part of an industrial waste survey. It should be initiated as soon as possible and maintained at all times since it stimulates industrial

cooperation and provides additional input for the entire industrial waste program.

8. The Buffalo Sewer Authority determined that because of the large amount of resources, expertise and short time duration required for the initial sampling and analysis program, it was cost effective to utilize a consultant to perform the work under the Authority's supervision.

9. The initial sampling and analysis of the industries discharging into the sewerage system was conducted by the city, instead of utilizing industrial self-monitoring for three reasons:

A. This would provide more reliable data to serve as a baseline for its continuing program.

B. The data obtained would be more consistent in that the same sampling and analytical procedures would be used.

C. Economy of scale can be realized by having one central organization conduct all the sampling and analysis required.

10. The results of the sampling and analysis program provides the data necessary to develop cost recovery, user charges and industrial waste control programs.

11. An in-plant investigation which physically locates discharge points, water sources and sampling locations is essential to the success of the sampling phase of the industrial waste survey.

12. Industries generally have more than one connection to a sewerage system, which is an important consideration in planning an industrial sampling program. In Buffalo, the average for the initial 85 industries sampled was 2.3 connections/industry.

13. It is important to obtain more than one composite sample per industry to insure that the data obtained accurately estimates the industry's normal discharge. For the 85 industries initially sampled in Buffalo's survey, the average number of daily composite samples/connection was 3.1.

14. Although only 85 out of Buffalo's 420 wet (process wastewater) industries were sampled, this amounted to 85% of the industrial flow and served as a good basis for projecting loadings for the remaining industries.

15. The total cost for developing Buffalo's industrial waste program was approximately $450,000. The manpower allocation for each phase was:

Phase I - 6450 hours or 4.5 hours/industry to identify the 1466 industrial users at an estimated cost of $75/industry.

Phase II - 11,600 hours or 138 hours/industry to sample and analyze 600 composite samples for 85 industries at an estimated cost of $2,100/industry, plus capital expenditures.

Phase III - Similar to Phase II, however there are only minor capital expenditures.

The manpower allocation for developing the Industrial Waste Control Program was:

Sewer Use Regulation - 400 hours at an estimated cost of $11,000.

Cost Recovery and User Charge System - 800 hours at an estimated cost of $22,170.

Monitoring Program - 100 hours at an estimated cost of $2,400.

MATERIAL BALANCE

16. In order to establish meaningful discharge limits and to equitably distribute the cost of treatment to all users of its sewerage system, a publicly owned treatment works must define the volume and waste characteristics of each class of user, both point source and non-point source. This can be accomplished through a sampling program for industrial and domestic discharges and stormwater.

17. The industrial sampling, residential sampling, and the sampling at the treatment plant provided the basis for a material balance on Buffalo's sewerage system. The following are the results of the material balances for dry weather flow:

Over 83% of the arsenic, cyanide, cadmium, chromium, copper, lead, nickel and zinc are contributed by industry. Although only 5% of the mercury present was attributed to industry, the 57% contributed by the Scajaquada Creek may be of an industrial origin.

Industry contributes 34% of the BOD, 40% of the COD, 27% of the SS, and 38% of the phosphorus loadings.

18. Based on an analysis of the sewerage treatment palnt's influent during wet and dry weather, it was concluded that stormwater did contribute significant quantities of lead and zinc. However, the stormwater was not found to contribute measurable quantities of Cd, Cr, Cu, Ni, CN.

19. The heavy metal content of the sewage could result in high metal concentrations in the sludges and could have an effect on Buffalo's digestion process and sludge disposal options.

Accordingly, any operational problems caused by these metals would have to be reduced by an effective industrial waste program.

INDUSTRIAL WASTE CONTROL PROGRAM

20. It is necessary for a publicly owned treatment works in an industrial community to have a comprehensive industrial waste control program in order to meet today's more stringent requirements.

21. An enforceable sewer use regulation coupled with a permit system and a self-monitoring schedule was adopted as a most practical and economical industrial waste control program for Buffalo's needs.

22. Once an industrial waste control program has been established, it is essential that the publicly owned treatment works conduct or require a scheduled monitoring program.

23. Self-monitoring by each industry is more effective when the municipality has conducted the industrial waste sampling to establish a baseline for comparison with subsequent self-monitoring data. Buffalo's monitoring program includes self-monitoring by industry as a basis for its continuing cost and control programs. The treatment agency must periodically spot check the industrial discharges to insure that the information being supplied by the industrial self-monitoring program is accurate.

24. Based on the evaluation of the proposed federal standards of performance for industrial discharges into publicly owned treatment works, the use of production to establish effluent criteria was not recommended because it is complicated, administratively difficult to handle, time consuming, and not completely understood by all the personnel that would be frequently using it. The use of concentration as a base for establishing discharge limits is more practical from an administrative point of view, however, it requires a more rigid system of control to include monitoring and plant inspections.

25. In Buffalo, the use of a wastewater service charge based upon the waste's volume and strength was found to be the most equitable method for recovering the cost of treatment from all the classes of users.

26. Since Buffalo's treatment plant construction is regulated by PL 84-660, the use of an ad valorem tax in conjunction with the wastewater service charge, was found to be a good method for distributing the costs for that portion of the treatment plant set aside for future use and extraneous flow.

27. It was found to be cost effective to use one rate for

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16. ABSTRACT

The requirements and affects of the combined treatment of industrial and domestic wastewaters were investigated for the Buffalo Sewer Authority's sewerage system.

A comprehensive industrial waste survey was performed to obtain the required background information on industrial discharges. This coupled with material balances on the sewerage system provided the data necessary to develop industrial waste control and cost recovery programs.

The industrial waste control program for Buffalo included revised sewer use regulations coupled with a permit system and monitoring program.

A combination of ad valorem tax and wastewater service charges, based on waste strength and volume were used to recover the cost of treatment. An economic evaluation of the cost recovery and industrial waste control programs on the industrial users was performed.

A 95,000 liter/day activated sludge pilot study was conducted to evaluate the affects that industrial users will have on the treatment processes.

Three potential sludge disposal options (soil conditioning, landfill and co-disposal with refuse) were investigated for the disposal of the sludge generated by the combined treatment of industrial and domestic wastewater in Buffalo.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Activated Sludge, *Sewage Treatment, *Sludge Disposal, *Sludge Treatment, *Administrative Agencies, *Cost Sharing	Combined Industrial/Municipal, *Joint Treatment, *Pretreatment, Buffalo, NY	05D 06A 06C

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the domestic strength waste rather than charge each user based on their individual waste strengths. A surcharge would be levied on those users having waste strengths in excess of normal domestic waste.

28. It was found to be cost effective for industries to pretreat individually rather than having Buffalo expand its treatment capability to remove incompatible pollutants.

29. For seven of the nine electroplaters investigated in the Buffalo system, the economics favored pretreatment rather than dilution for meeting incompatible pollutant discharge limits. For the other two electroplaters, dilution was favored since they were only slightly in excess of the discharge limits.

30. The publicly owned treatment works will be able to recognize the industries using non-contaminated water for dilution purposes by comparing an industry's present water consumption to its historical usage.

31. For the Buffalo system, it was found to be cost effective for industries discharging high strength compatible waste, to pay the surcharges, rather than dilute their waste.

32. It is cost effective for some of the industries using the Buffalo system to use pretreatment of compatible pollutants and reduce or eliminate their surcharges.

33. From the results of the industrial waste survey, it was concluded that many industries could reduce or eliminate their surcharges by making simple, low cost, in-plant process modifications.

34. The cost effectiveness of pretreatment or dilution by industries either to meet sewer use regulations for incompatible pollutants or to reduce user charges and or surcharges for compatible pollutants will vary with each case. Important criteria are: quantity discharged, strength of waste and the corresponding dilution required, land availability for pretreatment facilities, and sludge disposal problems resulting from pretreatment.

35. For some industries that presently discharge directly to a receiving stream, it will be cost effective for them to discharge all or portions of their wastewaters to a publicly owned treatment works. Since this study was initiated, one industry that previously had a direct discharge to a receiving stream has entered the Buffalo system and two others are negotiating to redirect substantial portions of their discharges to the Buffalo system.

REMOVAL OF METALS

36. The results of the pilot plant study indicated that better than 60% removals could be expected for lead, chromium, and copper. Smaller, but significant removals, were also obtained for zinc and cadmium while the removals of nickel and cyanide were insignificant.

37. Based on these removals, the Buffalo Sewer Authority has a basis for predicting credits for industries that will reduce the degree of pretreatment required.

38. During the pilot study, significant incidental removals of heavy metals were obtained, however, the results were highly variable with the standard deviations of the removals ranging from 17.8 for nickel and 29.9 for lead.

39. This incidental removal of heavy metals will result in high metal concentrations in the sludge and could have an effect on Buffalo's digestion process and sludge disposal options.

40. Since Buffalo's new secondary treatment plant was designed for combined treatment, the industrial contribution of compatible pollutants is necessary for its efficient and economical operation.

41. The enforcement of Buffalo's sewer use regulations will result in a substantial reduction of the metal content in the influent to the waste treatment plant due to industrial pretreatment and reduce the likelihood of any operating problems caused by metals. The projected decrease will be greater than 48% for copper, lead, nickel, zinc, chromium and cadmium.

SLUDGE

42. The projected decrease in the influent's metal concentration due to industrial pretreatment will result in an improved sludge quality which may be suitable for disposal as a soil conditioner. The quantities of copper, lead, nickel, zinc, chromium and cadmium in the sludge will be reduced by at least 50% due to industrial pretreatment.

43. The sludges resulting from industrial pretreatment will have high metal concentrations and proper disposal methods will have to be employed. At the present time in Buffalo, landfill disposal of this type of sludge is broadly utilized.

44. Buffalo has three options for its sludge disposal: landfill, soil conditioning, co-disposal with refuse.

45. Of these three options, the industrial metal contribu-

tion significantly affects only the use of the sludge as a soil conditioner.

SECTION 3

RECOMMENDATIONS

INDUSTRIAL WASTE SURVEY

1. Where possible, an industrial waste survey should be conducted before the design of the treatment plant has been completed so that problem areas can be solved during the design stage rather than during the operation.

2. In-plant investigations should be an integral part of an industrial waste survey. They should be conducted far enough in advance of the sampling stage so that problems located by the in-plant investigation can be solved without interfering with sampling.

3. When time and money permit, the publicly owned treatment works should conduct on its own, the detailed sampling and analysis stage of the industrial waste survey to insure that the results obtained are accurate.

4. Before sampling and analysis is undertaken, strict quality control procedures should be adopted for taking and analyzing the samples. This will help to avoid legal problems stemming from the contesting results.

5. The sampling and analysis program for each industry should cover more than one day. This will help to insure that the data obtained, accurately estimates an industry's normal discharge.

MATERIAL BALANCES

6. The publicly owned treatment works should define the waste strength and volume for all classes of users, both point source and non-point source in its sewerage system. These are important considerations in establishing the discharge limits and an equitable cost recovery and user charge system.

7. Publicly owned treatment works can conserve their financial and manpower resources by approaching the problem systematically and by only performing detailed investigations on those users which have an effect on the sewerage system. For

example, the BSA initially sampled only 85 of the 420 wet industries and used the resulting data to develop its cost and industrial waste control programs. The 85 industries sampled represented 85% of the industrial flow and provide a good data base for establishing these programs.

INDUSTRIAL WASTE CONTROL PROGRAM

8. Publicly owned treatment works in industrialized communities should develop a comprehensive industrial waste control program. This program should not only establish discharge criteria, but also include a method for insuring that these criteria are met.

9. Every publicly owned treatment works should have the power and authority to enforce its regulations on all users of its system.

10. When industry performs the monitoring function, the publicly owned treatment works should spot check the industrial discharges to insure that the data supplied is accurate.

11. The use of production units to establish discharge limits is not recommended. Based on an evaluation of the proposed federal standards of performance for industrial discharges to publicly owned treatment works, it was felt that the use of production units would result in greater administrative problems, paper work, and cost than would a concentration basis.

12. When using concentrations to define discharge criteria, the publicly owned treatment works should strictly enforce its control program through monitoring and inspections to identify diluters.

METALS REMOVAL

13. A publicly owned treatment works should evaluate its potential for credits for the incidental removal of incompatible pollutants in its treatment plant. These credits can be used to lower the industrial pretreatment requirements.

14. If the heavy metal removals obtained in Buffalo's system are to be used to establish credits, then the high degree of variability in the results should be taken into consideration in establishing these credtis.

15. In establishing a credit, the publicly owned treatment works should evaluate the effects of the incidental removals on their sludge process and disposal options.

SLUDGE

16. The sludges resulting from industrial pretreatment should be disposed of properly. Necessary safe guards should be established where they are lacking, to insure that the sludge disposal is environmentally sound. Publicly owned treatment works should be cognizant of industrial pretreatment sludge disposal practices and should coordinate with the various solid waste agencies.

17. In light of the increasing fuel costs and air pollution requirements, the Buffalo Sewer Authority should re-evaluate its present sludge treatment and disposal methods.

18. A detailed investigation should be performed to determine which sludge treatment process and disposal method will be cost effective for Buffalo's secondary treatment plant. The scope of this investigation should be much broader than this study's investigation of how industrial waste effects the sludge disposal options.

19. From the data obtained during the industrial waste survey, it is recommended that more research efforts should be directed in the following two areas:

A. Development of more accurate and instantaneous methods of making analytical determinations of toxic materials.

B. Development of more data on removal mechanisms for heavy metals. With the data already compiled by this and other work, studies should be made on a full sized secondary plant for at least a year.

SECTION 4

INDUSTRIAL WASTE SURVEY

INTRODUCTION

In addition to sewage from residential sources, many of the country's publicly owned treatment works (POTW) also accept industrial wastewaters. Because industrial wastes exhibit wide variations in strength and toxicity, the inclusion of these wastewaters into a POTW necessitates additional planning and restrictions on the use of the sewerage system in order to protect the sophisticated advanced treatment processes. When a POTW treating industrial wastewaters accepts Federal Aid for the upgrading or construction of its sewerage facility, additional requirements are placed on that POTW. Three of these requirements are:

1. Pretreatment: Pretreatment of industrial waste is required in varying degrees to protect the sewerage system from damage and upset and also to insure that pollutants do not pass through the treatment works untreated.

2. Recovery of Construction and O&M Costs: The intent of this requirement is to insure that every user of a sewerage system pays his fair share of the treatment costs and that industry is not subsidized in the construction of the sewerage facility. This is accomplished by recovering costs in two areas: 1) construction or capital, and 2) operation and maintenance costs (O&M). Under Public Law 92-500, industrial users of the POTWs must repay their share of the construction costs funded by federal grants over a defined period of time not to exceed 30 years. In some instances, the portion of the construction costs funded by state grants may also require recovery. In addition to the construction costs, the annual O&M costs must be recovered by some type of user charge system whereby each user or class of user pays their proportional share of the O&M costs. Since the inclusion of industrial waste in a POTW system usually creates more than one class of user, the user charge system, in order to be equitable, must take into account the variance in waste characteristics of its users. This is normally accomplished by basing the charge on flow rate, waste strength, and volume.

3. NPDES Permit: All POTWs must secure a NPDES permit to legally discharge their treated effluent. In cases where the

POTW treats industrial waste, an additional section (IV) entitled "Industrial Waste Contribution to Municipal System" is required for every major contributing industry. A major contributing industry is defined as one that: 1) has a flow of 50,000 gallons or more per work day; 2) has a flow greater than 5% of the total flow received at the treatment plant; 3) has a toxic material in its waste stream; or 4) has a significant impact, either singly or in combination with other contributing industries on a publicly owned treatment work or on its effluent. Included on the form is production information as well as the industry's waste strength and volume.

In order for the public treatment works to meet these requirements, it must define who uses the system and the magnitude of the industrial contribution. To accomplish this, the POTW performs an industrial waste survey (IWS) which can be approached in three ways. Common to all three approaches, is the identification of the industries using the system. Once identified, the first method then estimates the specific industrial contributions from waste characteristics published in literature. The second method goes one step further by requiring that all major contributing industries submit to the POTW analysis of their waste streams for review. The third method differs from the second in that the POTW itself samples and analyzes each major contributing industry's discharge.

The Buffalo Sewer Authority (BSA) elected to use the third method in performing its industrial waste survey for two reasons. The first was that while estimates may be used to satisfy Part IV of its NPDES permit, for the first year, specific analytical data is then required by the second year and therefore the first method is only appropriate initially. The second reason for using method three was the questionable reliability of the results obtained from method two. By the BSA scheduling, sampling and analyzing the industrial waste stream themselves, they minimized the possibility of the results being obtained on non-typical production days or having some of the discharge and flow data omitted.

Shown in Figure 1 is the flow diagram the BSA used in developing its industrial waste control program. The IWS segment, outlined in dashed lines in Figure 1, was completed in three phases: identification, cross section sampling, and follow-up sampling.

PHASE I - IDENTIFICATION OF CONTRIBUTING INDUSTRIES

This first phase of Buffalo's IWS was an inventory stage and defined the magnitude of the following two phases. The first step was to compile a complete list of all types of non-residential users of the BSA system. The types of industries ranged from restaurants and laundries to steel mills and oil refineries, and included establishments in sewer districts outside the city limits, but tributary to the Authority's system, as well as the establishments within the city's boundaries.

Establishing the list of contributors was complex and time consuming. Through contacting various organizations and agencies, five primary sources were identified and subsequently used to establish the list of contributors. These were:

1. Existing sewer authority files
2. City and State industrial directories
3. Water records
4. Tax records
5. Telephone yellow pages

From these sources, a complete list consisting of 343 commercial and 1,123 industrial establishments was obtained. By preliminarily screening this list for known inconsequential contributing establishments, it was possible to reduce the number of establishments requiring further investigation to 631.

The next task was to evaluate further the remaining industries in order to estimate the characteristics of the waste discharged to the sewer. This screening process would allow a decision to be made as to which industries would require sampling and analysis. To obtain the specific data required to make this evaluation, an industrial waste questionnaire was developed for circulation to the selected industries. To stimulate cooperation and so that the industries would be acquainted with the IWS, a news release explaining the purpose and goals of the program, as well as the federal regulations requiring it, was published for one week in the local newspapers and included with the three page questionnaire sent to the 631 industries.

The first two pages of the questionnaire, Figures 2 and 3, requested information regarding production, employment, water use and number and location of sewer connections. The third page was for the chemical analysis of the plant's discharge and was only to be completed if a previous analysis had been performed.

While waiting for the return of the completed questionnaires, water data was obtained from the various water agencies for all the establishments. In addition, the establishments were preliminarily placed in Standard Industrial Classifications[2] (SIC) and a map atlas and coordination system for locating the establishments and their points of discharge was prepared. In order

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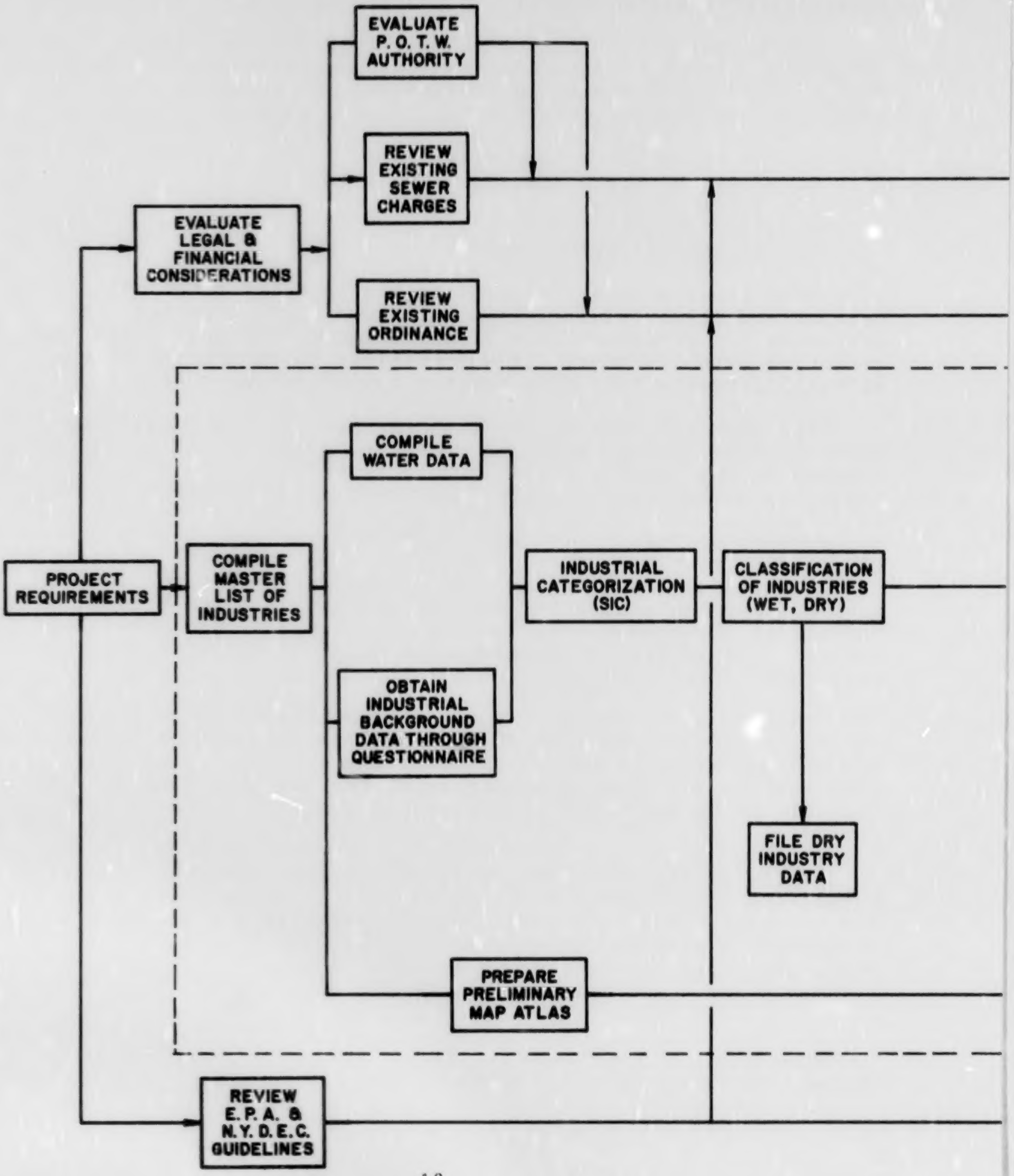
[2] Executive Office of the President. Standard Industrial Classification Manual. Washington D.C. 1972 edition. 649p.

FIGURE I - DEVELOPMENT OF AN


EVALUATE P. O. T. W. AUTHORITY
REVIEW EXISTING SEWER CHARGES
EVALUATE LEGAL & FINANCIAL CONSIDERATIONS
REVIEW EXISTING ORDINANCE
COMPILE WATER DATA
PROJECT REQUIREMENTS
COMPILE MASTER LIST OF INDUSTRIES
INDUSTRIAL CATEGORIZATION (SIC)
CLASSIFICATION OF INDUSTRIES (WET, DRY)
OBTAIN INDUSTRIAL BACKGROUND DATA THROUGH QUESTIONNAIRE
FILE DRY INDUSTRY DATA
PREPARE PRELIMINARY MAP ATLAS
REVIEW E. P. A. & N. Y. D. E. C. GUIDELINES

INDUSTRIAL WASTE CONTROL PROGRAM

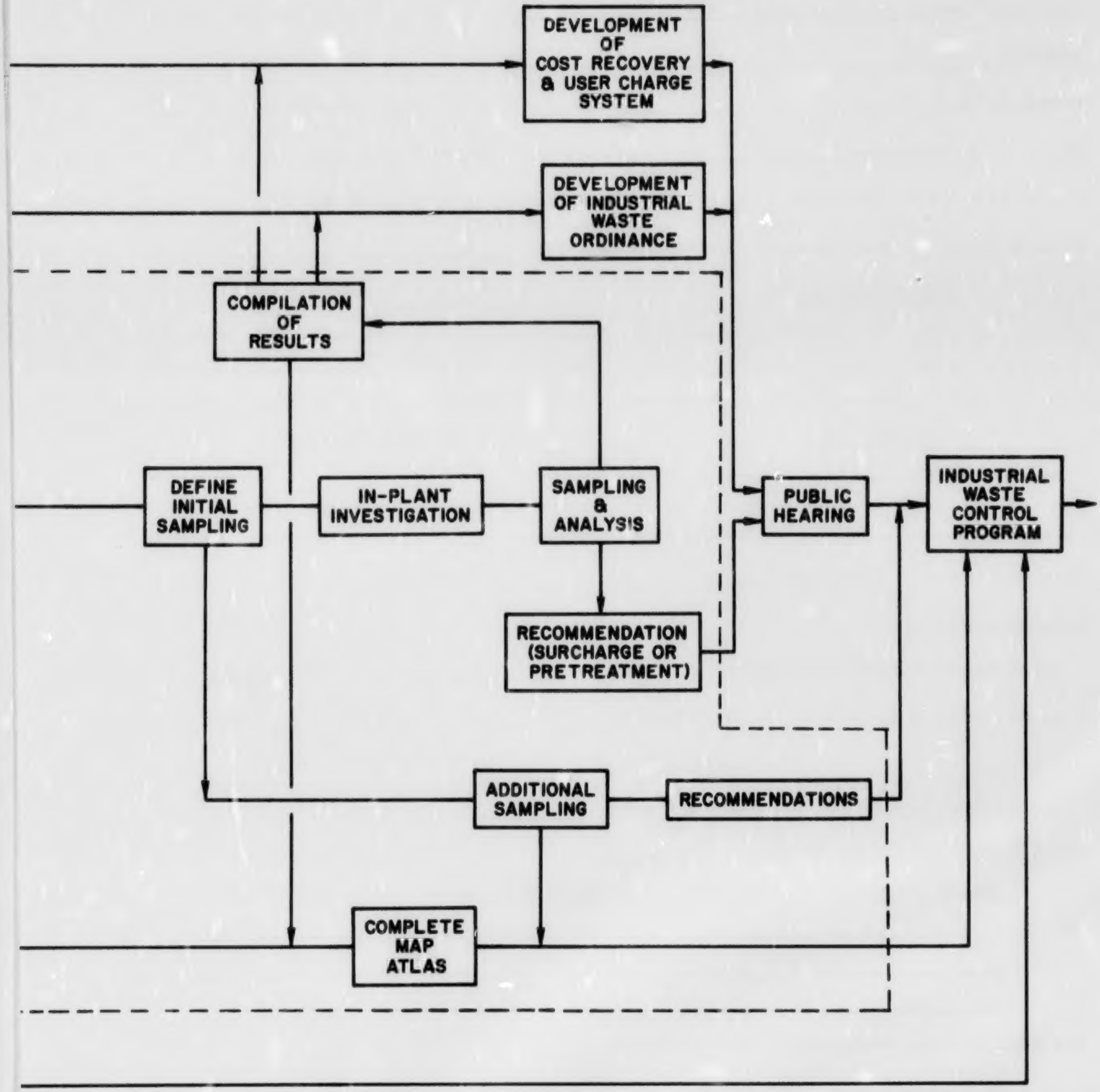

DEVELOPMENT OF COST RECOVERY & USER CHARGE SYSTEM
DEVELOPMENT OF INDUSTRIAL WASTE ORDINANCE
COMPILATION OF RESULTS
DEFINE INITIAL SAMPLING
IN-PLANT INVESTIGATION
SAMPLING & ANALYSIS
PUBLIC HEARING
INDUSTRIAL WASTE CONTROL PROGRAM
RECOMMENDATION (SURCHARGE OR PRETREATMENT)
ADDITIONAL SAMPLING
RECOMMENDATIONS
COMPLETE MAP ATLAS

Figure 2.

BUFFALO SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY

Sheet 1 of 3

Sic # ____________
Map# ____________
Loc# ____________
S.D. ____________
(For BSA use only)

Company Name ____

Address ____

Representative ____________________ Title ______________ Phone No. ________

Hours of operation/day ______________ Days of operation/week ______________

No. of employees: Shift No. 1 __________ Shift No. 2 __________ Shift No. 3 __________

Type of Business: (Manufacturer, Distributor or Retail) ______________________

RAW MATERIALS	AMOUNT PER YEAR

PRODUCTS	AMOUNT PER YEAR

Type of Process: Continuous ______________ Batch ______________

Industrial Wastes:

What waste products are disposed to: Sewer ______________ Other __________

Is discharge to sewer: Intermittent __________ Steady ______________

Quantity/day __________ Est. or measured __________

Are wastes pretreated? If so, which and how: ______________________________

Plant Sewer Connections to BSA

	Size & Shape	Material	Location in Plant	Connected To
(1)				
(2)				
(3)				

Are maps showing sewer connections available? __________

ADDITIONAL INFORMATION TO BE SUPPLIED ON YOUR LETTERHEAD.

Figure 3.
BUFFALO SEWER AUTHORITY
INDUSTRIAL WASTE SURVEY
Sheet 2 of 3

ANNUAL VARIATION IN OPERATION

Is there a scheduled shutdown?________ When?________

Is production seasonal?________

If so: Period of full production ________ to________

Period of limited production________ to________

Period of no production ________ to________

Employees (No.) Max.________ % of time at max.________

Min.________ % of time at min.________

If not: Average # of employees________

WATER USE

Source(s) of water________

If from an agency, Account #________

Water used for:

			Recirculated
Sanitary	________	gpd	
Air Conditioning	________	gpd	________
Process water	________	gpd	________
Jacketed cooling water	________	gpd	________

Other________

Period of max. water use________ Amount________

Period of min. water use________ Amount________

Water disposal other than sewer________ % of total________

Is water consumed in product?________ Amount/day________

Type and number of air pollution devices________

Have the waste streams been previously analyzed?________

Are radioactive isotopies used in your process?________ Specify:________

to minimize any confusion which may arise with industries having similar names or locations, the coordination system was used to reference all industries. This was accomplished by assigning each industry a code number consisting of: the number of the map atlas sheet on which it was located and its location number on that sheet. When a distinction was to be made between an industry's various connections to the BSA's system, each connection was assigned a number which was included in the code. For example, code number 24-12-3, refers to connection number 3 of industry number 12 on the 24th sheet of the map atlas.

The response to the questionnaire was very poor and slow; one month after the initial mailing, only 25% of the industries had returned the forms. Of this 25%, approximately 60% were returned incorrectly completed or with much of the important data omitted. A particular problem was encountered with the non-manufacturing establishments. Many of these either did not return the questionnaire or returned them marked "non applicable". Many of these firms did not consider their waste industrial in nature. However, service type establishments such as laundries, car washes, barrel reclaimers and hospitals have wastes which may have high organic loadings, toxic materials or both and it is important to include these in the sampling and analysis phase of the survey. To obtain the remaining questionnaires and the omitted data, it was necessary to follow up on 90% of the questionnaires sent out. Phone calls, sometimes repeated phone calls, and scheduled plant visits, where an engineer had to help the firm complete the forms, were utilized to obtain the data. In the case of non-manufacturing establishments, one method which was found to be effective in obtaining completed questionnaires was to tailor the cover letter, included with the questionnaire, to specific classes of establishments and thereby direct their attention to areas we considered significant in completing the questionnaire. In retrospect, it was found that approximately 40% of the establishments returned the questionnaire with some reminding by phone; 30% of the questionnaires were completed over the phone, and 30% of the questionnaires were completed by plant visits.

As completed questionnaires with production data were received, their SIC classifications were finalized. A small number of companies surveyed were found to be either out of business, moved out of the service area, or were synonymical with other firms. This reduced the number of establishments to 605. Table 1, below, shows the breakdown of industrial users of the BSA system.

Table 1. INDUSTRIAL OCCURRENCE BY SIC DIVISIONS

Major Title	Occurrence
Division A - Agriculture, Forestry, and Fishing	2
Division C - Construction	4
Division D - Manufacturing	417
Division E - Transportation, Communiciations, Electric, Gas, and Sanitary Services	14
Division F - Wholesale Trade	35
Division G - Retail Trade	31
Division I - Services	102
Total	605

From the quantity of water used, the number of people employed, and the production data, the industries were classified as wet (process wastewater) or dry (non-process wastewater), of which 185 were classified as dry. The wet industries were then further analyzed as to the type of raw materials used, the quantity of water consumed and whether the discharges consisted of process water or cooling water. The industries' wastewaters were then categorized into organic (toxic and non-toxic) and inorganic (toxic and non-toxic). Of the 420 industries classified as wet, it was postulated that 309 should be investigated further. The recommendations for further investigation is based on the industry's potential as a revenue source or the industry's potential for violation of the existing or future sewer use regulations. Shown in Table 2 is the distribution of the 420 industries by water usage.

Table 2. INDUSTRIAL DISTRIBUTION BY VOLUME

Water Usage-MGD		Number
>1 MGD		4
>0.5	<1	5
>0.2	<0.5	19
>0.1	<0.2	29
<0.05	<0.1	32
<0.05		331

From these 309 industries, 85 (representing a cross-section of the significant types of industries found in the Buffalo service area) were selected for sampling in the next phase. These 85 industries were the largest in their respective SIC categories.

PHASE II - CROSS-SECTION SAMPLING

The backbone of any industrial waste survey, is the sampling and analysis program. The sampling and analysis of wastes from the major contributing industries within a large municipal system provides the data necessary to make sound engineering judgements and decisions with respect to:

1. Locating and identifying the major industrial discharges.
2. Locating and identifying violators of the Sewer Regulations.
3. Development of a system of protection for the municipal treatment works to include the enforcement of a Sewer Regulation.
4. Recommending pretreatment systems which will satisfy the the POTW's requirements; and
5. The development of an equitable cost recovery system for capital as well as operating costs.

Phase II was designed to be a cross-section sampling program to speed up the development of the new Sewer Regulation, cost recovery system and method for controlling the discharges into the BSA system. Even though the number of industries sampled was reduced from 309 to 85 for this phase of the project, 11 months were required for completion. For the 85 industries sampled, 600 composite samples were analyzed and the data compiled for use in developing the above programs.

Since the Phase II sampling program included 84% of the total flow from Buffalo's industrial community, it was felt that these results would provide a good background for estimating BSA's total industrial and commercial loadings. The estimate was completed by using the sampled results in each SIC category as an average loading for other industries not sampled but in the same category. If all 309 industries were to have been included in this phase, the development of the above mentioned programs would have been delayed a year to eighteen months. The sampling and analysis program was carried out in four stages as follows:

1. In-plant investigation
2. Scheduling of industries for sampling
3. The sampling and analysis
4. Reporting

Each industry was handled as an individual case and passed systematically from one stage to the next thereby providing continuity to the program and at the same time allowing for any delays in the program due to poor weather, equipment breakdown, and curtailment of production by industry. A map was used to divide the industries into groups according to their location within the study area to minimize travel time between locations.

The in-plant investigation played a major role in the success of the sampling program. Investigative teams, consisting of an engineer and technician, revisited each industry to determine the following:

1. The number of discharge lines to the BSA system and the type of waste being discharged through them:

Because of the age of most of the industrial buildings in Buffalo and the lack of information with regard to the location of their waste discharge lines, it became necessary to investigate thoroughly each plant's sewer system. In many cases dye was used to locate and isolate the various points of discharge. If it could be determined that any particular lateral conveyed solely sanitary waste, that lateral was eliminated from the program. This determination, however, could be made in only a few cases. Where possible, the production processes using each lateral were determined as well as the pretreatment methods used, if any.

2. The accessibility of the discharge point for sampling and flow measurement:

At locations where accessibility to discharge lines was limited, samples were secured through vent pipes or cleanouts. Where transmission lines were accessible, "V" notch weirs or other flow measuring devices were fabricated to suit the needs at that particular location. It was found that many industries, even those discharging large volumes, used multiple "Y" type connections to the street sewer rather than consolidating their discharges through one or two manhole connections. Approximately 70% of the 85 industries sampled used "Y" type connections.

3. Location and number of water sources:

Water meters played an extremely important role in the determining of plant flow. In cases where it was impossible to make direct flow measurement, the total waste consumption was used to estimate the plant discharges. The inspectors tried to determine if the industry was receiving water from any sources other than the city water department. However, in some cases, this could not be determined until after the flows were measured.

Upon completion of the in-plant investigation, a sketch of the plant locating the points of discharge and water meters was prepared. From the previous data obtained on the industrial waste forms, a preliminary analysis sheet outlining the analysis to be performed on the sample was completed and the number of sampling days and compositing times were assigned (see Figure 4). In most cases, the duration of the composite time for each sample coincided with the normal work day for the particular industry to be sampled. Composite rather than grab samples, were used even for determining heavy metal concentrations, since a grab

FIGURE 4. XYZ EXAMPLE RECOMMENDATION
APPENDIX "A"

Company

XYZ Company
112 Park Lane
Lancaster, New York

SIC No. 3325
Map Loc. 67-24
Sample Points 3
Production Hrs. 24
Compositing Hrs. 24

Surcharge

Primary - Test results indicated that when E.C.S.D. #4 becomes tributary to the Buffalo system, XYZ Company should pay an industrial waste surcharge for excess suspended solids.

Secondary - When the new treatment plant goes on stream, no additional surcharges should be added unless the character of XYZ's waste changes.

Ordinance Violations

During the sampling program, the waste from XYZ's sample point #1 was in violation of the sewer ordinance's grease and oil provisions. In addition, concentrations of lead and phenols were measured at higher than acceptable levels.

Water Balance

Allowance - None

Discharge - 450,000 gpd

Cooling & Process - 414,000 gpd

Sanitary - 36,000 gpd

Special Requirements

Pretreatment - Before entrance into the Buffalo system is permitted, XYZ Company must pretreat its waste to eliminate the above ordinance violations.

Control Manholes - We recommend that XYZ provide control manholes on their discharges equipped with continuous monitoring equipment to pro-

Figure 4 continued. XYZ EXAMPLE

B.S.A. INDUSTRIAL WASTE SURVEY
PRELIMINARY ANALYSIS
SHEET

Company XYZ Company
Code 67-24-01

Date
Sampling Point #1

Map Loc. # 67-24
No. of Samples 3
Type of Sample Composite
Hrs of Sampling 24
No. of Sample Points 3

Parameters	Analyze For	Parameters	Analyze For
pH	X	Arsenic	
BOD (5 day)	X	Cadmium	
COD	X	Chromium hexavalent	
Chlorine Demand	X	Chromium-total	
Color	X	Copper	
Total Solids	X	Lead	X
TSS	X	Iron	X
Settleable solids		Manganese	
Grease & Oil	X	Mercury	
Phenols	X	Nickle	X
Chloride		Zinc	X
Sulfate			
Sulfides			
Total Phosphorus	X		
Cyanide	X		
T.O.C.			
Ammonia Nitrogen			

Figure 4 continued. XYZ EXAMPLE
SAMPLE COLLECTION
FIELD SHEET

Industry XYZ Company
Code No. 67-24-01
Time of Installation 10:30 AM
Date of Installation Day 1

Collector DSB
Type of Sample Composite
Method of Sampling Dipper & DC
Hrs of Sampling 24
Grab Sample Required yes
Size of Outlet Weir

DATE:	Day 1	Day 2	Day 3	Day 4	Day 5
Weather	Cloudy	Cloudy	Cloudy	Clear	Clear
Waste Stream Temp.	$6^{o}C$			$1^{o}C$	
Time Sample Collected	Installed	8:00 AM	Installed	9:30 AM	10:10 AM
Volume Sample		3/4 gal		$1\frac{1}{4}$ gal	0 gal
Time Grab Sample #1	10"30 AM			9:35 AM	
Time Grab Sample #2					
Time Grab Sample #3					
Initial Depth of flow	$1\frac{1}{4}$" over weir		1" over weir	$1\frac{1}{4}$" over weir	1 3/8" over wei
Flow Meter Range	15"		$7\frac{1}{2}$"	$7\frac{1}{2}$"	$7\frac{1}{2}$"
Flow Meter Base Reading	set at 12		set at 5	set at 5	set at 5
Initial Water Meter Reading	Refer to Supplemental Field Sheet				
Time of Initial Reading					
Final Water Meter Reading					
Time Final Water Meter Reading	10:15	8:15	10:30	9:45	10:00
REMARKS		Remove equipment			Motor battery DOA, sample

Certified Correct________

Figure 4 continued. XYZ EXAMPLE

SUMMARY ANALYSIS SHEET

Company: XYZ Company

Sample Point: #1

Code: 67-24-01
Type of Sample: Composite
Hrs. of Sampling: 24

Map Loc.# 67-24
No. of Samples: 3
No. of Sample Points: 3

Parameters Date:	Day 1	Day 2	Day 3	Day 4	Day 5		
pH	8.1	9.4	6.7				
BOD (5 day)	17.2	45	7.5				
COD	722	1042.2	446				
Chlorine Demand	5.55	12.10	16.5				
Phenol	0.210	0.155	0.02				
Total Solids	2688	5412	1916				
TSS	2340	5160	1850				
Grease & Oil	8.31	2.38	101.9				
NH_3 - N	15.0	10	1.0				
Total Phosphorous	5.4	26.2	2.0				
Arsenic							
Cyanide	0	0	0				
Cadmium							
Chromium Hex.							
Chromium Total							
Copper							
Iron	35.90	88.10		76.0			
Lead	0.19	0.44		0.20			
Manganese							
Mercury							
Nickel	0.06	0.11		2.2			
Zinc	0.23	0.51		0.13			
Discharge							
Flow Measured MGD	.2985	.2711	*.2652	*.2652	.2260		

* Average Value

FORM APPROVED
OMB No. 158–R0100

FOR AGENCY USE

Figure 4 continued. XYZ EXAMPLE

STANDARD FORM A–MUNICIPAL

SECTION IV. INDUSTRIAL WASTE CONTRIBUTION TO MUNICIPAL SYSTEM

Submit a description of each major industrial facility discharging to the municipal system, using a separate Section IV for each facility description. Indicate the 4 digit Standard Industrial Classification (SIC) Code for the industry, the major product or raw material, the flow (in thousand gallons per day), and the characteristics of the wastewater discharged from the industrial facility into the municipal system. Consult Table III for standard measures of products or raw materials. (see instructions)

1. Major Contributing Facility (see instructions)

Name 401a XYZ Company

Number& Street 401b 112 Park Lane

City 401c Lancaster

County 401d Erie

State 401e New York

Zip Code 401f 00000

2. Primary Standard Industrial Classification Code (see instructions) 402 3325

3. Principal Product or Raw Material (see instructions)

			Quantity		Units (See Table III)
Product	403a	Castings	8		W6
Raw Material	403b	NA			

4. Flow Indicate the volume of water discharged into the municipal system in thousand gallons per day and whether this discharge is intermittent or continuous.

404a 450 thousand gallons per day

404b ☐ Intermittent (int) ☒ Continuous (con)

5. Pretreatment Provided Indicate if pretreatment is provided prior to entering the municipal system

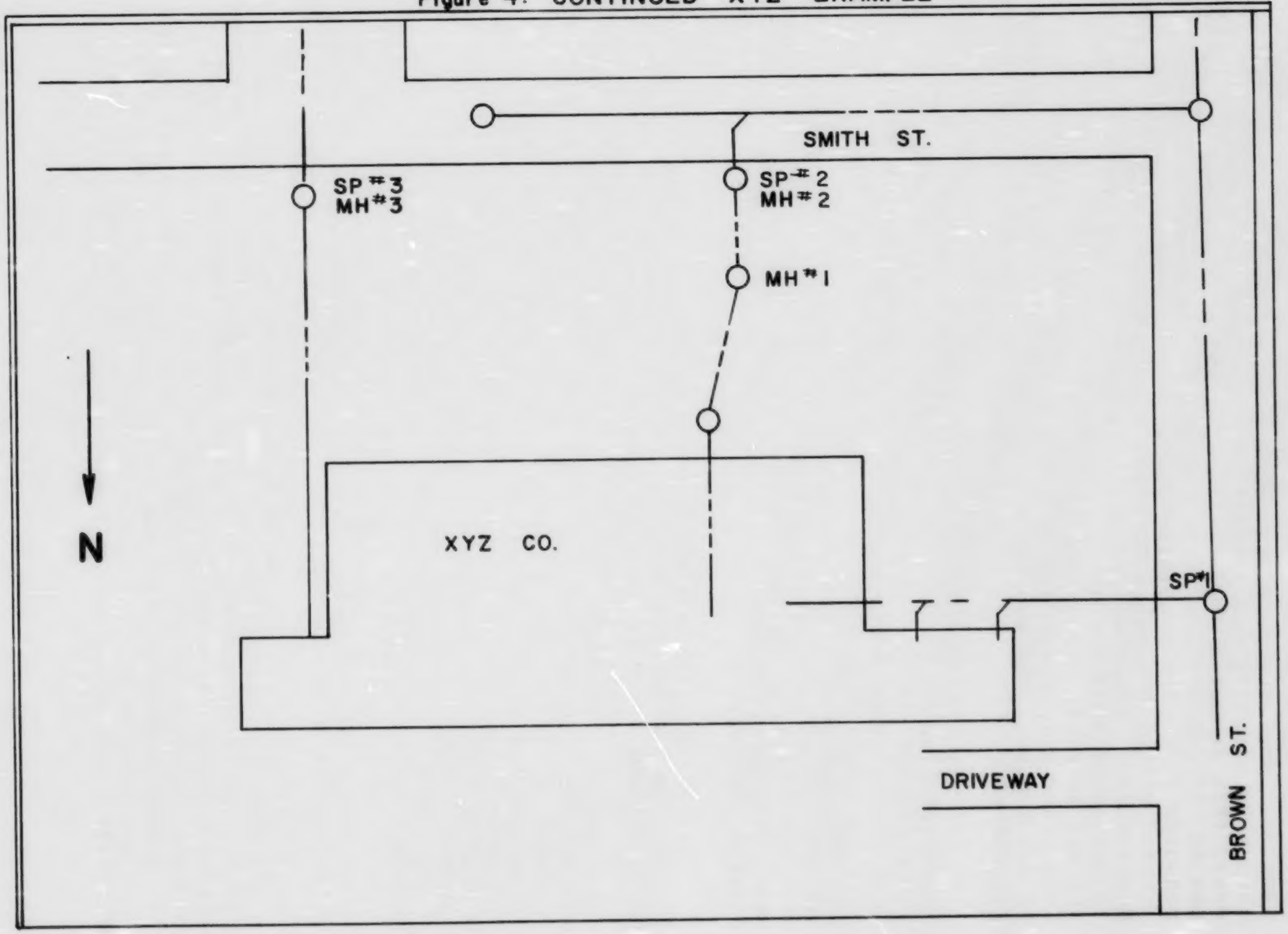
405 ☐ Yes ☒ No

6. Characteristics of Wastewater (see instructions)

	Parameter Name	BOD	COD	T. Solid	S.S.	P	Phenol	CN
[illegible]	Parameter Number	00310	00340	00500	00530	00665	32730	00720
[illegible]	Value	45	852	3572	2320	12.2	0.88	ND

Parameter	Fe	Pb	Ni	Zn	G&O
406a	01045	01051	01067	01092	00550
406b	59.0	0.48	1.05	0.56	83.8

Figure 4: CONTINUED XYZ EXAMPLE


SMITH ST.
SP#3
MH#3
SP#2
MH#2
MH#1
N
XYZ CO.
SP#1
DRIVEWAY
BROWN ST.

sample can give misleading information unless the industry's discharge is always the same, both in volume and strength. In most cases, automatic samplers were employed to obtain the necessary samples. Wherever possible, flow proportionate samples (ie. frequency of sampling was proportional to flow) were obtained. However, this amounted approximately to 30% of the total due to the use of "Y" connections to the sewer (ie. no manholes for flow measurement). The remaining 70% were time composite samples where a fixed volume was taken at fixed time intervals over the production day. The time intervals varied from one every ten minutes to one every thirty minutes. To insure that the data obtained was not severely biased due to the particular production activity, industries were sampled from a minimum of two days to a maximum of seven days. The average for the 85 industries was 3.1 samples per industry.

The majority of the industries surveyed had more than one discharge line to the BSA system. The average for the 85 industries sampled was 2.3 connections per industry with a range of from one to seven connections.

The number of discharge points an industry uses greatly affects the effort required to sample and analyze its discharges. Multiple discharge points and abnormal production hours place heavy demands on equipment and manpower which require good prior planning and scheduling to minimize difficulties.

One of the problems which was encountered during the Phase II sampling was in obtaining reasonably accurate flow data for each sampling location of a particular industry. For an industry having one discharge point, flows could be estimated from their water meter(s) readings, however, this method could not normally be used for industries having multiple discharge points unless it could be established that the water meter serviced only that portion of the plant drained by the discharge point in question. For these "problem" industries, flow data was obtained by plant inspections whereby plant and BSA personnel estimated the percentage of water used by each process and which discharge line it drained to. In this manner, a rough approximation of an industry's discharge could be obtained. Control manholes, in which flows could be accurately measured, were then required for those industries which had either potentially surchargeable wastewater or sewer regulation violations.

Industries were scheduled for sampling according to location rather than by similarities in waste characteristics, to minimize travel time. Two variables affected establishing the initial schedule; equipment requirements and the number of discharge points at each industry. Since the physical characteristics of the various sampling locations varied widely from location to location, some adjacent industries being sampled were initially by-passed until the proper piece of equipment was freed for that installation. The number of discharge points at a particular industry also affected the sample scheduling since all discharge points of a particular industry should be sampled at the same time. In cases where industries had five or six discharge points, they were initially by-passed and returned to when all discharge points could be analyzed at the same time.

Samples and flow data were collected on a routine basis at the end of each work day for the particular industries being sampled. Field sheets were kept by the field crew for each sampling point. The field sheet contained all pertinent information with respect to the samples being collected and flow measurement (see Figure 4). To insure that errors as to the origin of each sample could not be made, each sample was labeled with a code number and date which keyed it to the field sheet, preliminary analysis sheet and industrial waste map atlas. The use of the map atlas location number, as the sample code number, made a very convenient cross reference.

After being received in the laboratory, the lab crew matched the coded numbers on the sample containers to the codes on the anlaysis sheets which told them which analysis to perform on that particular sample. The routine analysis consisted of such parameters as BOD, COD, TSS, phosphorus and chlorine demand. For approximately 45% of the industries, heavy metal parameters were also included.

In order that the recommendations for each individual industry would be instituted as soon as possible, monthly preliminary reports were prepared. Each report contained sufficient information to document the survey, characterize plant operations, indicate problem areas in sampling or analysis and make recommendations regarding cost recovery and ordinance violations. Figure 4 gives an example of a report prepared for a fictitious industry. By utilizing this cross section sampling, the cost recovery, sewer use control and sewer regulation programs could be developed while the remaining recommended industries were sampled.

PHASE III - FOLLOW-UP SAMPLING

This phase was designed to provide the required information on the remaining 224 industries not yet sampled and at the same time mate with the industrial waste program being developed from the Phase II study. Approximately one year from the completion of the Phase II study, the Buffalo industrial waste program was functioning and staffed. By this time, 79 additional industries had been sampled and final recommendations were made for these and the 85 initially completed. Since Buffalo now has its own functioning industrial waste section, the remaining 145 industries will be sampled as part of their permit requirements established for the control portion of their industrial waste program.

MANPOWER AND DIRECT COST PLANNING

The total cost for developing Buffalo's industrial waste program was approximately $450,000 or $0.75 per person served by the sewerage system. This cost can be misleading when applied to other POTWs since the program was designed to satisfy the specific needs of Buffalo. So that Buffalo's experiences can be related to other POTWs, an approximate manpower effort for each stage of the industrial waste control program's development was made.

Phase I

The first phase of the Buffalo IWS took approximately five months to complete and did not incur any direct costs. The manpower requirements occurred primarily on four levels: Project Engineer, Engineer, Engineering Aid and Clerical. An approximation of the effort for each level is as follows:

Project Engineer	- 1450 hrs.	or	1.0 hr./industry
Engineer	- 2000 hrs.	or	1.4 hr./industry
Engineering Aid	- 2000 hrs.	or	1.4 hr./industry
Clerical	- 1000 hrs.	or	0.7 hr./industry
Total	- 6450 hrs.	or	4.5 hr./industry

It must be kept in mind that the manhours/industry total shown is an average based upon the more detailed investigation of the 631 industries sent questionnaires and the remaining 835 industries eliminated in the preliminary screening. At an average hourly rate of $16.75/hour, the cost/industry would be $75.38.

Phase II

The second phase of the IWS involved inspection, sampling, analysis and data compiling for 600 composite samples from 85 industries and was completed in approximately eleven months. Assuming existing laboratory facilities, direct costs are incurred for such items as:

Vehicle	- $4,000	- $ 6,000
Safety Equipment and Tools	- $ 750	
Sampling Equipment	- $3,000	- $ 9,000
Flow Measuring Equipment	- $2,800	- $10,000

If an existing laboratory had to purchase additional equipment to analyze the industrial samples, direct costs would increase by $20,000 to $35,000.

The minimum manpower requirements for inspection, sampling, analysis and data compilations, would be approximately:

Clerical - 1500 hrs. of 2.5 hr./comp.
Field Crew (2 man crew) - 3000 hrs. or 5.0 hr./comp.
Chemists - 3500 hrs. or 5.8 hr./comp.
Field Engineer - 3000 hrs. or 5.0 hr./comp.
Project Engineer - 600 hrs. or 1.0 hr./comp.

Total 11,000 hrs. 19.3 hr./comp.

Using the Phase II average of 3.1 composites/connection and 2.3 connections/industry, the manpower requirements averaged 137.6 hrs./industry. At an average hourly rate of $15.50/hour, the cost/industry would be $2,135.

Phase III

The third phase manpower requirements were similar to Phase II, however, since the same equipment was used, no additional direct costs were incurred.

Development of the Industrial Waste Control Program

As previously mentioned, the information generated by the first two phases of the IWS was used to develop a sewer regulation and cost recovery system. The approximate effort required to develop these programs was as follows:

Sewer Regulation:
Project Engineer - 200 hrs.
Engineer - 150 hrs.
Clerical - 50 hrs.

Total Hours - 400 hrs.
Total Cost - $11,000

Cost Recovery & User Charge System:
Project Engineer - 400 hrs.
Engineer - 325 hrs.
Clerical - 75 hrs.

Total Hours - 800 hrs.
Total Cost - $22,200

Monitoring Program:
Project Engineer - 30 hrs.
Engineer - 50 hrs.
Clerical - 20 hrs.

Total Hours - 100 hrs.
Total Cost - $ 2,400

SECTION 5

MATERIAL BALANCE AROUND THE SEWAGE SYSTEM

INTRODUCTION

In order to develop an equitable cost recovery and surcharge system for all classes of users (ie. industrial, commercial, and residential) and to properly establish incompatible pollutants discharge limits, the POTW must first know the volume and waste characteristics of each class of user. The industrial waste survey described in the previous chapter provides the data for one class of user. In addition, the loadings from other sources such as residential, infiltration and inflow must also be determined.

By performing material balances on its sewerage system, the POTW gains the needed additional information on the various components of its system to accurately proportion the costs of providing treatment fairly. In addition, the results of the balances indicate what additional restrictioning is required and what effect these restrictions will have on the performance of the waste treatment facility. For example, in the Buffalo system, prior to this study, it was not known what portion of the organic loading received at the treatment plant was contributed from industrial sources. It was also not known whether or not the industrial contribution was a benefit or a hinderance to Buffalo's treatment system. In addition, there were questions about the magnitude of the domestic and stormwater contributions of trace elements should be restricted in order for Buffalo to meets its NPDES requirements. It is important to know the answers to all of these questions when developing an industrial waste control program.

In performing the balances, the BSA's system was broken down into five types of contributors as shown in Figure 5, with the following parameters investigated.

BOD
COD
TSS
Phosphorus
Arsenic
Cadmium
Chromium
Copper
Cyanide
Lead
Mercury
Nickel
Zinc
Flow

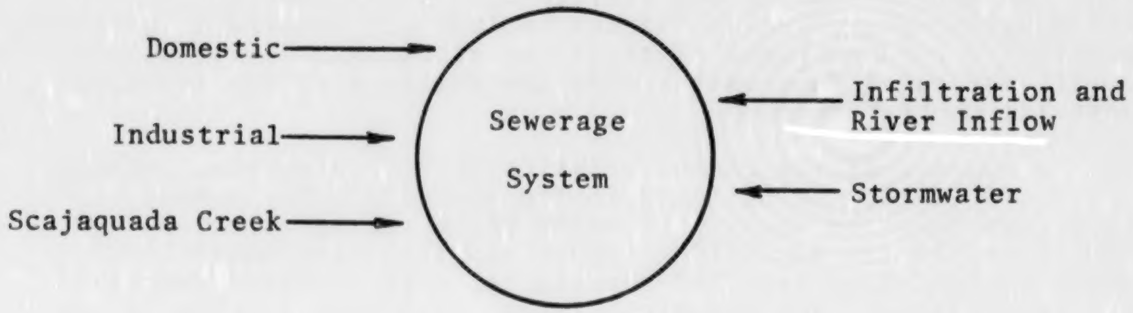


Figure 5. CONTRIBUTORS TO BSA'S SYSTEM

ESTIMATION OF DOMESTIC CONTRIBUTION

Domestic waste from approximately 700,000 persons is received by the Sewer Authority from residential sources both within the city and from outside districts. While fairly good estimates can be made for BOD and SS loadings from literature, the same cannot be said for trace elements. To obtain an estimate of the trace element loadings, a sector of Buffalo's residential community was examined. To enhance the accuracy, flow proportion samples were obtained and analyzed for three days. Of the trace elements, only lead, mercury and zinc were found in measurable quantities above what is normally found in Buffalo's drinking water.

In order to get the domestic contribution of the loading to the treatment facilities, a water balance had to be developed. This was accomplished by obtaining the average amount of water supplied daily by Buffalo's water department and subtracting the industrial consumption and the system's losses. Based upon 1974 population figures, the resulting per capita consumption was 610 liters/day (161 gpd) which is reasonable for unmetered sources such as is the case in Buffalo.

ESTIMATION OF INDUSTRIAL CONTRIBUTIONS

The information obtained during Phase II of the BSA's industrial waste survey was used to estimate the industrial portion of the total loading received at the Bird Island Treatment Plant. The first step was to classify the 420 wet industries into 210 SIC subcategories covering seven major SIC divisions. The second step was to obtain an average loading of the sampled industries in each subcategory. The average loading was then applied to the remaining industries in each subcategory. The loading for each sampled subcategory was then totaled and an average industrial loading rate established. Since the sampled industries accounted for 84% of the total industrial flow contributed to the BSA system, the application of the average industrial loading rate to those subcategories which did not include any sampled industries provided a good estimate of their contribution. The totalization of all the categories established the estimate of the total industrial contribution.

A summary of the characteristics of SIC categories investigated, Table 26, can be found in the appendix. The summary shows not only the quality of waste which can be expected from industries in the same SIC category and their estimated loading, but also indicates areas of concern for cost recovery and sewer use regulations. For example, of the industrial loading to the treatment plant, the electroplaters category (#3471) contributes 58% of the cadmium, 39% of the nickel, and 21% of the cyanide. Discharge controls for this category would result in significant reductions in the overall loadings of these parameters received at the Authority's Bird Island plant. If in the future, problems arise with regard to these parameters, the electroplaters category would be a prime candidate for investigation. The much lower but still significant contributions of other trace elements indicate that the Authority must have a much more detailed program of surveillance.

ESTIMATION OF SCAJAQUADA CREEK CONTRIBUTION

The Scajaquada Creek is a natural waterway flowing westward to the City of Buffalo. As Buffalo was developing, more and more sewage entered the creek through overflows until finally it was enclosed at the city line and made an integral part of the sewer system. The Buffalo Sewer Authority has a long term project underway to divorce the stream from its sewer system, however for planning, it was included as a contributor.

While organic analytical data is available on the stream's quality where it enters the city's sewerage system, metals concentrations had to be obtained from grab samples. Flow data was readily available from the USGS gaging station at the city line.

The results of the Scajaquada Creek sampling indicated that there were three parameters present in quantities that should cause concern: phosphorus, cyanide and mercury. Approximately 56% of the mercury, 21% of the phosphorus and 10% of the cyanide loadings received at the Bird Island plant are contributed by the Scajaquada Creek. Industries upstream of the Scajaquada Creek's connection to the BSA system are probably the sources of these substantial loadings. This raises a serious legal question as to whether the BSA has the jurisdiction to control these industrial discharges to meet their NPDES permit requirements.

ESTIMATION OF STORMWATER CONTRIBUTION

In estimating the stormwater contributions to a sewerage system such as Buffalo's, there are many factors which should be considered, such as the variation in precipation due to the geological location of the study area. In Buffalo the influencing factor is Lake Erie. Rain and snow squalls may fall in one portion of the city while other portions remain dry. Storm frequency is an important factor since during extended dry periods, large quantities of pollutants may build up in the sewers and on the streets. Thus, the next substantial storm brings higher than normal concentrations of the various pollutants to the treatment plant. It is very possible that these concentrations could read toxic or inhibiting levels causing upset or loss of efficiency at the facility. All these factors should be carefully examined and evaluated in making an analysis of the effects the stormwater has on the system.

The method used to investigate Buffalo's stormwater contribution was to compare the concentrations and loadings for wet and dry days found at the treatment plant during the pilot operation. While exact values cannot be obtained by this method, it was used to show general patterns since time and money did not permit a more detailed investigation. Of particular interest to this study were the stormwater loadings for trace elements since these loadings could have a bearing on the pretreatment requirements imposed on the industry. From the information supplied by literature,[3,4,5] it would seem that during storms preceded by dry weather, the concentrations of metals during the initial wet period would increase due to the quantities washed from the streets and sewers. However, in general, this was not found to be true. For all the pollutants other than lead, the average and mean concentrations for wet weather were less than those for dry weather. This indicated that the stormwater diluted the quantities found in the dry weather sewage. Further confirmation was obtained by comparing the concentrations of the plant's influent on wet days which are preceded by four or five dry days (first flush), to the influent concentrations obtained on the remaining days. Since a first flush occurrence build-up of pollutants in the system, the concentrations measured on a first flush occurrence should be significantly higher than those measured on other days. Unfortunately, the study period

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[3] Toxic Materials Analysis of Street Surface Contaminants. EPA-82-73-233.

[4] Sarton J., Boyd G., and Agardy F. Water Pollution Aspects of Street Contaminants. Journal WPCF. Vol. 46. No. 3. March 1974. p458-467.

[5] Newton C.D., Shephard W.W., Coleman M.S. Street Runoff as a Source of Lead Pollution. Journal WPCF. Vol. 46. No. 5. May 1974. p999-1000.

was generally wetter than normal and only two days could be considered a first flush: November 18th and December 7th. Lead was the only parameter investigated which definitely showed a higher concentration on the first flush days. The first flush results for zinc, the only other trace element which had a wet weather loading higher than its dry weather loading, were not conclusive since the increases on the first flush days could be attributed to higher industrial activity as was observed on dry days. In addition, the wet weather loadings, Table 3, with the exception of lead and zinc, followed the same pattern as was observed for the wet and dry concentrations. This indicated that stormwater was only contributing measurable quantities of lead and zinc during the study period. Stormwater was not found to contribute measurable quantities of cadmium, chromium, copper, nickel or cyanide.

Table 3. TOXIC POLLUTANTS LOADINGS - WET vs. DRY WEATHER

	Wet Loading - kg/day			Dry Loading - kg/day		
		non-exceedance			non-exceedance	
Parameter	Avg.	50%	90%	Avg.	50%	90%
Cadmium	0.0013	0.0011	0.0023	0.0020	0.0016	0.0041
Chromium-T	0.0131	0.0142	0.0331	0.0232	0.0229	0.0402
Copper	0.0128	0.0117	0.0227	0.0129	0.0125	0.0238
Lead	0.0126	0.0075	0.0318	0.0072	0.0075	0.0112
Nickel	0.0045	0.0038	0.0115	0.0050	0.0043	0.0110
Zinc	0.0363	0.0142	0.0682	0.0291	0.0235	0.101
Cyanide	0.0046	0.0036	0.0087	0.0049	0.0045	0.0079
Flow-mg/day	801.7	755.1	1105.2	723.8	658.2	752.5

It should be noted that, due to the numerous overflows in the Buffalo Sewer System, during times of heavy rain significant quantities of rain diluted sewage overflows into the lake and rivers. If the quantity of the overflows were included in the wet weather balance, the metal loadings would increase, however, since Buffalo Sewer System is largely combined sewers, the concentration of metals at the plant would probably remain the same.

ESTIMATION OF INFILTRATION AND INFLOW CONTRIBUTIONS

During the study, economics and time did not allow for direct measurements to establish the infiltration and inflow contributions to the system. Therefore, it was necessary to make estimates from other sources. While in fact, the quantity and quality of infiltration and inflow varied widely across the city, for this balance, it was assumed to be constant. For the Buffalo system, inflow may occur during dry weather due to the lake or river levels being higher than the overflow chamber's inverts, causing these waters to flow into the BSA system. Based on the Authority's average infiltrate rate, 70.8 million liters/day was estimated for the flow contribution. To simplify the balances, the quality of Lake Erie water was assumed to be a good estimate of the quality of infiltration and inflow and was used to predict their contributions.

RESULTS OF THE MATERIAL BALANCES

Summarized in Table 4, are the results of the material balances for four of the five types of contributors to the Buffalo system. These balances apply only to dry weather conditions since the uncertainty of storm occurrences preclude considering the stormwater contributions in the balances. The balances clearly indicate some important characteristics of the Buffalo system which must be taken into account not only in developing cost recovery and sewer use programs, but also in future planning. One of the most important areas identified by the balances is that, with the exception of mercury, over 82% of each of the trace elements loading is contributed by industry. This indicates that an industrial waste control program will effectively reduce these loadings to an acceptable minimum.

A second important area identified was compatible pollutant loadings for use in an equitable cost recovery and user charge system. In addition to establishing the loadings attributed to each class of user, the balance showed that 23% of the flow and 21% of the phosphorus loadings were contributed by non-point sources. This clearly pin-points an area where the Authority should direct its efforts and thus reduce the sizable operation and maintenance costs of those non-point source contributions which at present must be recovered from the point source users. (ie. residential and industrial).

Table 4. DRY WEATHER MATERIAL BALANCES ON THE BUFFALO SEWERAGE SYSTEM

Parameter	Domestic	Industrial	Infiltration and River Inflow	Scajaquada Creek
BOD				
Kg/day	50,400	28,900	2,300	2,500
% of Total	60	34	3	3
Conc.-mg/l	123	327	32.5	33.3
COD				
Kg/day	114,390	83,570	5,500	7,380
% of Total	54	40	2.5	3.5
Conc.-mg/l	280	944	78	98.4
TSS				
Kg/day	46,000	18,300	600	2,600
% of Total	68	27	1	4
Conc.-mg/l	112	207	8.5	34.7
Phosphorus				
Kg/day	590	570	0	300
% of Total	40	39	0	21
Conc.-mg/l	1.44	6.44	–	4.00
Arsenic				
Kg/day	–	0.018	–	–
% of Total	0	100	0	0
Conc.-mg/l	≤0.01	0.0002	≤0.01	≤0.01
Cyanide				
Kg/day	1.04	26.5	–	3.03
% of Total	3	87	0	10
Conc.-mg/l	0.003	0.299	≤0.02	0.04
Cadmium				
Kg/day	–	4.02	–	–
% of Total	0	100	0	0
Conc.-mg/l	≤0.01	0.045	≤0.01	≤0.01
Chromium				
Kg/day	–	126.6	–	–
% of Total	0	100	0	0
Conc.-mg/l	≤0.01	0.43	≤0.01	≤0.01
Copper				
Kg/day	2.96	128.0	0.7	–
% of Total	2.2	97.3	0.5	0
Conc.-mg/l	0.007	1.45	0.01	≤0.01
Lead				
Kg/day	4.09	24.6	0.07	0.76
% of Total	13.9	83.3	0.2	2.6
Conc.-mg/l	0.01	0.278	0.001	0.01
Mercury				
Kg/day	1.18	0.15	–	1.67
% of Total	39.3	5.0	0	55.7
Conc.-mg/l	0.003	0.002	≤0.001	0.022
Nickel				
Kg/day	–	63.9	–	–
% of Total	0	100	0	0
Conc.-mg/l	≤0.01	0.722	≤0.01	≤0.01
Zinc				
Kg/day	50.4	283.0	2.82	–
% of Total	15.0	84.2	0.8	0
Conc.-mg/l	0.123	3.20	0.04	≤0.01
Flow				
Megaliters/day	409	88.5	70.8	75.7
% of Total	63.5	13.7	11.0	11.8

SECTION 6

DEVELOPMENT OF AN INDUSTRIAL WASTE PROGRAM

INTRODUCTION

Of all public utilities, wastewater collection and treatment systems are probably the most abused. This abuse stems from the common misbelief that a sewer can carry any unwanted material that can be put in it. This misuse of the public sewerage system can affect the efficiency of the system, as well as increase the operating and replacement costs to the users.

There is certainly no question that many problems experienced in sewage treatment can be eliminated or to a great extent controlled by the proper regulation of the use of the sewerage system. In an industrial area this control can only be brought by an effective industrial waste program which includes not only regulations on the use of sewers but also a method of enforcement.

Based on the finding of the Industrial Waste Survey and the resulting material balances, the Buffalo Sewer Authority elected to use sewer use regulations coupled with a permit system and monitoring program to establish its industrial waste controls.

LEGAL AUTHORITY

Before any municipality, Authority, or treatment and collection agency can control the waste being discharged into its system, it must first have the power and authority to enforce such a regulation. In the case of the BSA, they do have the power and authority of control under Item No. 8, Section SS1403 of the Laws of New York State - by Authority. To provide a means of control over other municipalities wishing to use the Authority's sewage system, a contractual agreement is used. In order to meet today's requirements for equitable cost recovery and pretreatment, the power to control industrial discharges must not stop at the point where the outside municipalities interceptor sewer enters the Authority's sewerage system, but rather should extend to the industry's front door. Thus the BSA requires compliance with its sewer use regulations and cost recovery and user charge system. Every outside sewer district is required to enter into a contractual agreement with the BSA.

The BSA's ordinance and cost recovery program are specifically made a part of these contractual agreements. In this manner, the industrial users outside of the city limits, like the industrial users inside the city, are required to obtain permits and participate in the cost recovery and monitoring programs as well as allow access to the BSA, EPA, County and State officials for discharge inspection.

DETERMINATION OF DISCHARGE LIMITS REQUIREMENTS

Before a POTW can develop its sewer use regulations, it should evaluate the federal, state and local requirements to insure compliance with the most stringent. At the time BSA's study was undertaken, it was anticipated that the standards of performance and pretreatment standards for the majority of industrial discharges into POTWs would be promulgated and that the Best Practical Control Technology Currently Available (BPCTCA) would establish the federal effluent criteria. However, as of this writing, most of the standards for discharge into POTWs are only proposed. In addition, EPA is considering amending its determination of the discharge criteria from a loading per production unit basis to a concentration basis.

New York State's requirements are on a concentration basis but they have not established any firm guidelines since each POTW is evaluated based upon the magnitude of its industrial discharges, the type of treatment process employed, and the water quality standards of its receiving stream. Since New York State had no applicable guidelines, the proposed Federal requirements for discharge into POTWs were evaluated to determine their applicability for use in controlling industrial dischargers served by the BSA.

In making this evaluation, three major problem areas were encountered. The first was that in general, industries did not keep the type of production records required to determine their allowable discharge. Many industries were even reluctant to give an estimate based on the required production units since they felt that the production basis for determining discharge was too complex and it was information which was confidential and they did not want to impart it. The second problem area was how to handle plants having a varied product line. Many of the industrial users of the Buffalo system have either more than one product line or associated processes such as captive plating lines. To further complicate this problem, the waste streams from the various production lines are often discharged through common sewer laterals. The third problem was that there was not enough information available in the published effluent guidelines to determine the allowable discharges. Even with the aid of the Development Documents used to establish the guidelines, the determination of what was specifically included was difficult and sometimes not possible.

Based on this evaluation, the BSA had adopted the concentration method of expressing discharge limits because it was felt that the use of production units to establish effluent criteria would result in greater administrative time, paperwork and cost on the part of the Authority. For example, using the production basis, when the BSA monitors the discharge from a job shop plater to insure compliance with the regulations, it could easily spend four or five manhours just in determining the allowable discharge limits for the sampled period since this type of plater not only changes its quantity and type of plating from day to day, but also the type of pieces plated.

SEWER USE REGULATIONS

The BSA's sewer use regulations were established to provide for the maximum possible beneficial public use of the Authority's facilities through regulations of sewer construction, sewer use and industrial wastewater discharges.

The results from the Phase II IWS indicated areas of concern which were not covered under its old sewer regulations. Thus, from the old regulations, a new regulation was developed to meet BSA's expanding needs and match the sophistication of the new secondary treatment plant. The new regulation, coupled with a monitoring program enforced by the BSA's industrial waste staff provides the tools necessary to control the wastes discharged into the system.

Buffalo's sewer use regulations were developed around four major requirements, control of the construction of sewers and connections, establishment of prohibited and limited discharge criteria, control of industrial discharges, and establishment of an enforcement procedure for violations of the regulation. Two of these requirements, establishment of prohibited and limited discharges and controlling industrial discharges, were greatly expanded over the old regulation.

In establishing the prohibited and limited waste discharge criteria, a distinction had to be made between which wastes would not be allowed at all and which would be allowed in limited concentrations. The prohibited wastes section, in general terms included all wastes which would be hazardous or harmful to either the sewerage system, public health or the receiving stream. Since the BSA's limits were established in concentration terms rather than production units, an antidilution clause was included to prohibit the discharge of any water for the purpose of diluting wastes which would normally exceed applicable maximum concentration limits. This clause established the basis for the illegality of dilution to meet discharge limits.

The limited discharge concentrations, Table 5 below, was established by initially setting the limits based on the applicability of other existing ordinance limits on the BSA system then refining them to meet New York State Requirements. A copy of the entire Sewer Use Regulations can be found in the appendix.

Table 5. BSA's LIMITED DISCHARGE LIMITS

Parameter	Concentration mg/l
Chromium (total)	2.0 mg/l
Chromium (trivalent)	1.0 mg/l
Chromium (hexavalent)	0.1 mg/l
Copper	0.4 mg/l
Zinc	0.6 mg/l
Nickel	1.0 mg/l
Cadmium	0.2 mg/l
Arsenic	0.1 mg/l
Barium	1.0 mg/l
Lead	0.1 mg/l
Manganese	1.0 mg/l
Silver	.05 mg/l
Boron	1.0 mg/l
Mercury	.01 mg/l
Selenium	.05 mg/l
Cyanide	0.8 mg/l
Phenolics	0.1 mg/l
Grease and Oil	50.0 mg/l

The BSA's NPDES permit establishes certain discharge limits which must be met. To meet these limits, the Authority must not only operate its treatment plant efficiently, but must also control industrial discharges to insure that they do not either upset the treatment plant or pass through untreated. In formulating the control method that best suited the Buffalo system, four alternatives were evaluated and ultimately utilized, to varying degrees, in Buffalo's Industrial Waste Control program.

1. Enforcement of Sewer Regulations:

In the past, with only a primary system, the "Enforcement of the Sewer Regulations" has been a satisfactory method for controlling discharges. However, a more sophisticated treatment process, increasingly demanding federal and state requirements and a fluctuating industrial community, this system alone no longer provides an adequate level of control. Under this method, the industries are not required to report changes in their production methods or flow rates. In short, the Sewer Authority has no way of monitoring changes in the waste characteristics. In addition, by simply enforcing the sewer regulations, the BSA is not providing a convenient means by which they can obtain production data and waste characteristics. When the new treatment plant is completed and in operation, this data will become essential for evaluation of industrial waste surcharges and to insure BSA's compliance with Part IV of their NPDES permit.

2. Contractual Agreements:

Contractual agreements with each industry would offer the BSA the maximum possible control. The reason for this being that a contract is a specific and legally binding agreement between two parties and is readily enforced in a court of law. As one would imagine, to negotiate a contract with each major contributing industry in a city the size of Buffalo would be obviously far too expensive and time consuming. However, it may be advisable for the Sewer Authority to consider having contractual agreements with isolated problem industries.

3. Continuous Monitoring Program:

The third method would be a continuous monitoring program to insure that each industry is complying with the sewer regulations. This method has, in the past, been proven to be very effective. However, it would require a large staff of chemists and engineers to collect and analyze the samples from each industry. Here again, the cost associated with such a program would be excessive.

4. Permits:

The permit system seemed to be the most practical and workable method; however, permits alone will not insure adequate control. It must be coupled with a strong enforceable sewer use regulation and an industrial self-monitoring program. This means that industries would be required to sample and analyze their own waste streams and report the results to the BSA on a routine schedule. To insure that the data being supplied to them is accurate, the POTWs could spot check the waste from the industries in question.

As previously mentioned, a sewer regulation alone is not going to control the wastes being discharged to a municipal system. Therefore, a program of enforcement and specific monitoring procedures were developed. As called for in the new regulations, the permit system coupled with an industrial self-monitoring program was adopted as the most practical, economical and workable method to adequately satisfy Buffalo's needs.

BUFFALO'S PERMIT SYSTEM

Upon enactment of the new sewer regulations, every industrial and commercial establishment is given six months to obtain an industrial waste permit. A completed application would contain all the information the BSA would require to evaluate the industry's waste stream. Based on the questionnaire, the Sewer Authority will decide:

1. Whether or not the discharge is of a surchargeable nature.
2. Whether or not the discharger will be required to provide pretreatment.
3. Whether or not the discharger should self-monitor.
4. Whether or not further investigation is required.

After the BSA's industrial waste staff has evaluated the applications and has made its recommendations as to which industries should: 1) pretreat their wastes; 2) pay an industrial waste surcharge; 3) install a control manhole; and/or 4) self-monitor; a formal letter stating the conditions under which the waste would be accepted will be sent to the discharger. In some cases the Authority may ask the discharging industry to submit an industrial wastewater facilities report, to insure that the pretreatment which is proposed will be adequate and a time table for achieveing acceptance will be agreed upon by the applicant and the Authority.

After all the requirements for the permit are met, a second letter, formally accepting the waste would constitute the permit. In addition, industry may be required to self-monitor to insure compliance with their permit. This requirement will be discussed in more detail in the following subsection.

BUFFALO'S MONITORING PROGRAM

The monitoring program is an essential part of an industrial waste control program. The IWS conducted by the Authority provided an accurate data base and check enabling the use of industrial self-monitoring to provide the required data in the continuing program to reduce the expense and work load on the Authority. However, spot checks by the Authority will be used to maintain the integrity of the self-monitoring program. A preliminary schedule has been drawn up, see Table 6, establishing the frequency of both industrial and BSA monitoring. In addition to establishing a monitoring schedule, Table 6 also summarizes the industries': pretreatment requirements, flow and SIC code; thereby providing the pertinent data for each industry in one reference. The frequency of the required monitoring was based upon the quantity and characteristic of the wastes discharged by each industry. If an industry did not have any violations or surcharges, then self-monitoring was not required, however, the BSA will periodically spot check industries which do not self-monitor for changes in their waste characteristics.

Since the results of the monitoring program are used to establish: user charges, compliance with sewer use regulations,

Table 6. SUMMARY OF PRETREATMENT AND MONITORING SCHEDULE

Industry	SIC #	Flow lpd	Control M.H.	Improved House-keeping Required For	Pretreatment		Monitoring Schedule		Applicable Unit Processes
					Update	New	Self	B.S.A.	
44-7	2011	101,800						Spot check	These unit processes also apply to SIC codes 2014 and 2077. 1. Improve in-plant control practices a) blood recovery b) handling of paunch manure as solid waste 2. Course solid seperator 3. Removal of all floating oil and grease 4. Neutralization
44-24	2011	39,400	X	Solids, G & O			Annually	Every two years	
44-6	2011	73,800	X	Solids			Annually	Every two years	
44-5	2013	1.018 MLD	X	Solids				Annually	
38-11	2013	210,100	X		G & O		Bi-annually	Annually	
45-2	2013	424,300	X	G & O				Annually	
38-12	2013	275,200	X	G & O	pH, solids		Quarterly	Annually	
37-7	2013	901,200	X		pH		Quarterly	Annually	
32-13	2021	103,700	X			G & O		Every two years	These unit process also apply to SIC code 2023. 1. Improve in-plant control practices by recycling of by-product 2. Removal of grease and oils 3. Equalization 4. Neutralization
56-6	2022	111,700	X			G & O	Quarterly	Annually	
33-13	2024	839,900	X			G & O	Bi-annually	Annually	
34-13	2026	1.098 MLD	X	Solids			Monthly	Bi-annually	
24-2	2026	709,300	X			G & O	Quarterly	Annually	
23-6	2047	157,500	X					Spot check	
23-10	2051	186,600	X			G & O pH	Annually	Annually	
9-2	2051	243,400	X					Annually	
27-9	2079	1.540 MLD	X			G & O	Quarterly	Annually	

or a combination of both, the monitoring requirements are stringent. Samples taken in proportion to flow are preferred and required in some cases. However, samples composited over the work day are usually acceptable. To allow for normal production variations, analysis is required on samples collected over three to five consecutive work days. Registration is required of all laboratories performing analysis for industrial self-monitoring to insure that all the analytical procedures, quality control, and sample preservation methods being used are uniform and in accordance with BSA standards. In addition, to minimize conflicting results between the industrial analysis and the BSA spot checks, the Authority provides the opportunity for the industry to split samples taken during the monitoring period.

PRETREATMENT

Some of the industries will be required to pretreat their waste. From an industrial point of view, the pretreatment of waste streams will serve two purposes: (1) to eliminate violation of the sewer regulations, and (2) to reduce industrial waste surcharges.

From a municipal point of view, the pretreatment of industrial waste will reduce loadings at the treatment plant, minimize the chance of process upset due to toxic pollutants, and improve the quality of the sludge. This requirement is outlined in the Federal Register, Issue 40 CFR 128, and is further elaborated on in the Federal Guidelines, entitled "Pretreatment of Pollutants Introduced into Publicly Owned Treatment Works," published by the U.S. Environmental Protection Agency in October 1973. Therefore, using the above as a guide, the BSA formulated its own pretreatment policy.

After reviewing the federal and state policies concerning pretreatment, the following policies were adopted by Buffalo.

1. Joint treatment of domestic wastewater and adequately pretreated industrial wastewater is encouraged where it is economically advantageous.
2. In-plant measures to reduce the quantity and strength of industrial wastewater flows would be beneficial to joint treatment, and should be encouraged.
3. Pretreatment requirements should be based on an individual analysis of the permitted effluent limitations placed on an industry and on the potential for adverse effects to the treatment works.

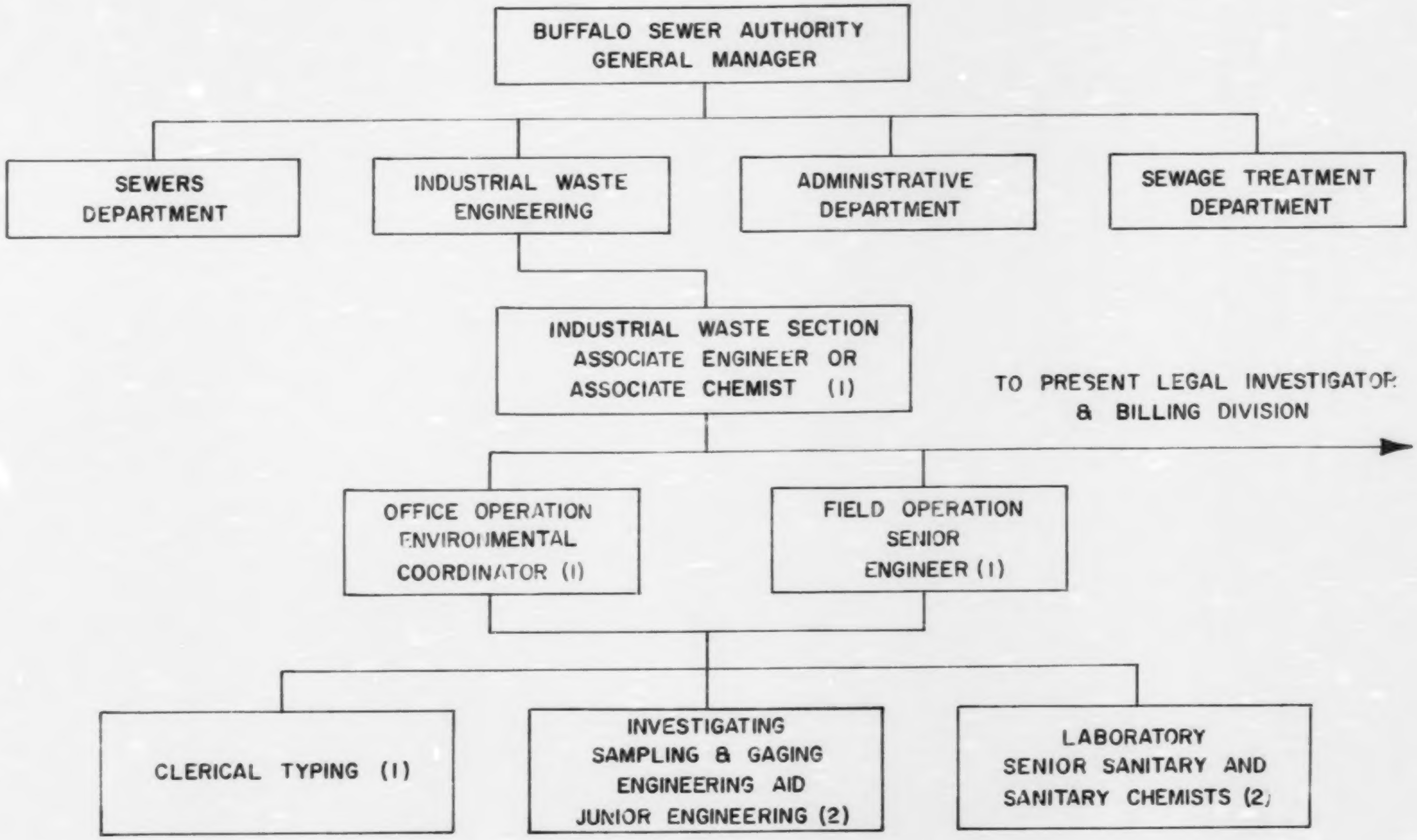
INITIAL WORKINGS OF BUFFALO'S INDUSTRIAL WASTE PROGRAM

Buffalo's industrial waste program was finalized approximately one third of the way through Phase III of the IWS and was staffed according to the Organization Chart present in Figure 6.

Figure 6

ORGANIZATION CHART

PROPOSED INDUSTRIAL WASTE SECTION


BUFFALO SEWER AUTHORITY GENERAL MANAGER
SEWERS DEPARTMENT
INDUSTRIAL WASTE ENGINEERING
ADMINISTRATIVE DEPARTMENT
SEWAGE TREATMENT DEPARTMENT
INDUSTRIAL WASTE SECTION ASSOCIATE ENGINEER OR ASSOCIATE CHEMIST (1)
TO PRESENT LEGAL INVESTIGATOR & BILLING DIVISION
OFFICE OPERATION ENVIRONMENTAL COORDINATOR (1)
FIELD OPERATION SENIOR ENGINEER (1)
CLERICAL TYPING (1)
INVESTIGATING SAMPLING & GAGING ENGINEERING AID JUNIOR ENGINEERING (2)
LABORATORY SENIOR SANITARY AND SANITARY CHEMISTS (2)

The Authority felt that even though additional requirements were to be placed on the industrial users of their system, the transition to and acceptance of the new program could be harmonious. To facilitate the implementation of the new program, the Authority approached the change over in the following manner: to approach the industries with an attitude of cooperation and to solicit ideas thereby stimulating public participation. Instead of demanding compliance, the industries were asked to work along side the BSA so that together they would be able to meet BSA's NPDES permit requirements.

A series of public meetings were held to explain the new program and to obtain an exchange of ideas. This method has been successful and has stimulated an attitude of cooperation between the BSA and the industries it serves. The initial feeling of industry is that the public meetings were extremely helpful in gaining a good understanding of the program.

SECTION 7

ECONOMIC ASSESSMENT OF BUFFALO'S COMBINED TREATMENT

INTRODUCTION

The starting point in assessing the economics of combined treatment is to estimate what the capital (construction) and operation and maintenance (O&M) costs will be. Once a good estimate is obtained, methods for the recovering of the costs of providing treatment can be developed.

In order to qualify for participation in the federal government's financing program for grant funds to POTW's and where the considered project includes treatment of industrial waste, the grantee must assure the granting agency that it has or will have in effect an equitable cost recovery and user charge system. The Environmental Protection Agency promulgated specific requirements with respect to establishing and implementing these systems in the Federal Register, Volume 39, Number 29, 40 CFR, Part 35, State and Local Assistance, February 11, 1974. The requirements are as follows:

> § 35.925-11 User Charges
>
> That, in the case of grant assistance awarded after March 1, 1973, a project involving Step 2 or Step 3, an approvable plan and schedule of implementation have been developed for a system of user charges to assure that each recipient of waste treatment services within the applicants service area will pay its proportionate share of the cost of operation and maintenance (including replacement as defined in § 35.905-17) of all waste treatment service provided by the applicant and the applicant must agree that such systems will be maintained.
>
> § 35.925-12 Industrial Cost Recovery
>
> (a) That, in the case of any grant assistance awarded after March 1, 1973, for a project involving Step 2 or Step 3, signed letters of intent have been received by the applicant from each significant industrial user to pay that portion of the grant amount allocable to the treatment of its waste. Each such letter shall also include a statement of the industrial user's intended period of use of the treatment works. A significant industrial user is

> one that will contribute greater than 10 percent of the design flow or design pollutant loading of the treatment works. In addition, the applicant must agree to require all industrial users to pay that portion of the grant amount allocable to the treatment of wastes from such users.

Shown in Figure 7, is a graphical representation of the cost recovery and user charge system required under PL 92-500.

Once an industrial cost recovery and user charge system has been established, the industrial user can evaluate it in conjunction with the pretreatment requirements to determine the most economical solution for their specific needs. This evaluation may indicate that an industry should pretreat its compatible pollutants rather than pay a surcharge or that minor production changes or better housekeeping procedures should be instituted to lower surcharges or pretreatment requirements. In systems using a concentration basis for discharge limits the potential exists for industry to use dilution to either meet discharge limits or to reduce or eliminate surcharges. During this study, as will be discussed later in this section, consideration was given to these areas to indicate their effects on the Buffalo system.

BACKGROUND - COST RECOVERY AND USER CHARGE SYSTEM FOR BUFFALO

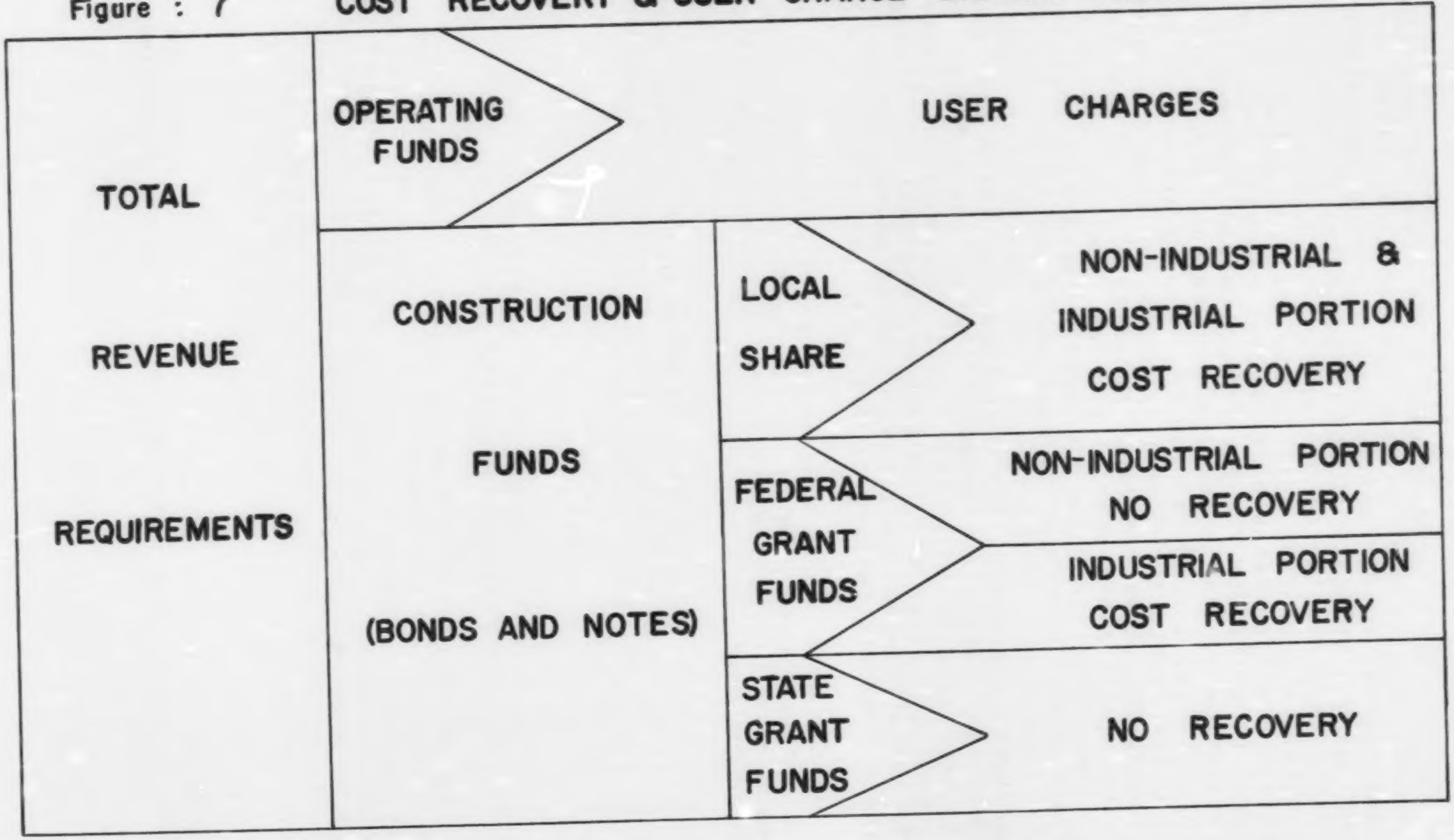
Since Buffalo secured their grant prior to March 1, 1973, the regulations governing the industrial cost recovery and user charges are those of PL 84-660 rather than PL 92-500. There are two basic differences between these two laws: first, PL 84-660 does not require the recovery of the industrial portion of the Federal grant, and second, the use of ad valorem tax will not satisfy the Federal requirement for user charges for PL 92-500. PL 84-660 requires the applicant demonstrate the use of ad valorem tax as the base for user charge. This is based on a decision made by the Comptroller General of the United States.[6]

The problems involved in developing a method by which the BSA should distribute its financial obligation to those that benefit from it is quite complex. The system must be based on the principle that the total annual revenue required for the operation of the sewage works should be distributed to the users and non-users for whose use, need and benefit the facilities are provided, approximately in proportion to the cost of providing the use and the benefits of that works.

In the past, the most commonly accepted method for raising

[6] Agee, James L. User Charge Systems. Program Guidance Memorandum. EPA. pg. 38. July 16, 1974. 1p.

Figure : 7 COST RECOVERY & USER CHARGE SYSTEM UNDER PL 92-500


TOTAL
REVENUE
REQUIREMENTS
OPERATING FUNDS
USER CHARGES
CONSTRUCTION
FUNDS
(BONDS AND NOTES)
LOCAL
SHARE
NON-INDUSTRIAL &
INDUSTRIAL PORTION
COST RECOVERY
FEDERAL
GRANT
FUNDS
NON-INDUSTRIAL PORTION
NO RECOVERY
INDUSTRIAL PORTION
COST RECOVERY
STATE
GRANT
FUNDS
NO RECOVERY

revenue has been based on assessed valuation.[7] Historically, communities, as they developed to the state of providing wastewater services, tended to use this means of raising revenue simply because it was traditionally used to support governmental functions. The simplicity of the system makes it very desirable since it requires no monitoring or sampling to determine charges and the accounting and billing work is minimal. In addition, real estate taxation provides means of financial contributions from undeveloped property for the benefits received from having a wastewater system available and ready to serve. From a tax payer's point of view, the ad valorem tax takes preference over the service charge since the former is a tax deductable expense. Overshadowing the above described benefits of an ad valorem tax are the inadequacies and special problems that are encountered in its use. One objection to an ad valorem based on a taxation system for wastewater treatment is that the users do not pay in proportion to their use of the system. For example, in industrialized areas such as Buffalo, the cost recovery system that favors the property tax places a disproportionately large charge for wastewater treatment on those industrial or commerical properties that produce little or no industrial wastewater. Similarily, those industries with a large volume of wastewater in proportion to their property investment would pay less than their fair share.

On the other hand, wastewater service charges can provide for financial support of collection and treatment systems when based on some scheme that reflects the actual physical use of the system, such as:

1. Volume of wastewater as determined by water meters.
2. Volume of wastewater plus pollutant load as measured by BOD, S.S., chlorine demand, phosphorus, etc.
3. Number and size of sewer connections.
4. Type of property, such as residential, commercial or manufacturing.
5. Number and types of plumbing fixtures.
6. Uniform rates per dwelling unit,etc.

The philosophy used here is that the cost is being distributed according to the benefit and use made of the system. Community benefit, readiness to serve, and ability to pay factors are not considered. One of the advantages of the service charge system is that it permits fair charges to churches, schools, organizations and other governmental units that are exempt for property taxes.

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[7] Financing and charges for Wastewater Systems. American Public Works Assc., American Society of Civil Engineers. Water Pollution Control Federation. 1973. p37-40.

An additional benefit that the wastewater service charge tends to provide is the reduction of wastewater being discharged from industries. When industry is paying for every liter, gm of BOD, S.S. and P, that is discharged, they may find that is has become more economical to improve the quality and/or reduce the quantity of their discharge. Such a reduction in wastewater volume or pollutant loading is generally advantageous to both the industry and the community.

On the negative side, the point can be raised that such a system does not provide for payment by undeveloped property as for the benefits of having facility capacity available whether used or not. It also does not consider the benefits the community derives as a result of having wastewater collection and treatment adequate for health protection, nuisance elimination and aesthetic enjoyment of waterways. In addition, how can the cost associated with infiltration, inflow and future use be equitably apportioned since these costs are not a function of a user's loading?

Thus, it is obviously unfair to raise the annual revenues required entirely by the ad valorem tax method. Similarily, it is unfair to expect the present users to pay the entire cost. Consequently, the best system to meet the revenue requirement for providing secondary wastewater treatment in an industrial community under PL 84-660 would be a combination of the two methods previously discussed, where part of the cost of the treatment works is obtained from charges to property or an ad valorem tax, special assessments and/or a special wastewater treatment surcharge.[8]

For the Buffalo system, a volume and loading base was used for the costs resulting from point source discharges, (ie. domestic and industrial) and an ad valorem base was used for the non-point source discharges (ie. infiltration, future use and Scajaquada Creek). While EPA has approved this method under PL 84-660 regulations, it would not be approved under PL 92-500[9].

COST RECOVERY AND USER CHARGE SYSTEM FOR BUFFALO

As previously mentioned, Buffalo cost recovery and user charge system was developed in concert with Public Law 84-660, therefore, the total share of the treatment facility and an ad valorem tax was used as a base for non-point source contributions.

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[8] Equitable Recovery of Industrial Waste Treatment Costs in Municipal Systems. EPA. October 1971. p5.

[9] Stoats, E.B. Decision - Use of Ad Valorem Tax to Satisfy Statutory Requirement for a User Charge System for Water Treatment Works. Comptroller General of the United States. B-166505. July 2, 1974. p2.

The BSA's secondary treatment plant has a number of design considerations (flow, BOD, S.S., PO_4) and the relative proportions charged to users and property owner, differ for the various unit processes. For example, the pump station, final settling tank, chlorine tank, plant outfall and modification to the gate chamber were all designed based on flow. Consequently, the costs should be distributed based on flow. On the other hand, the grit disposal facility, the modification of the primary tanks and the primary digestors were designed based on the suspended solids loading. Since the capital as well as the O&M costs of the treatment facility are directly related to the parameters for which it was designed, the allocation of the relative proportion of the works to the users of the system or the property owners should be based on these same parameters.

To derive the formula for the allocation of capital costs, the new plant was broken down into the twenty individual facilities with each being assigned its portion of the total cost relative to the appropriate design parameters. Table 7 shows the distribution for the estimated construction costs of BSA's new secondary treatment plant. This breakdown resulted in: 41.6% of the total construction costs being attributed to BOD removal; 30.8% to flow; 25.3% to S.S. removal; and 2.3% to PO_4 removal.

The allocation of the estimated first year O&M costs were arrived at in much the same manner with the costs of the fifteen unit operations being apportioned according to design parameters as shown in Table 8. This apportionment resulted in: 41% of the total O&M cost assigned to S.S. removal; 25.5% to flow; 17.5% to BOD removal; and 16% to PO_4 removal.

Based upon the material balances discussed in Section V, and the plant's design criteria, the loadings received at the plant were distributed to the users as shown in Table 9. Nineteen percent of the first year's costs, both capital and O&M will be collected from all taxable real property with the remaining 81% collected from users.

The preceding paragraphs laid the groundwork for the determination of unit rates, rate formulas and charges. The allocation of capital and operating and maintenance costs as shown in Table 9, relate the unit costs of waste treatment of each individual user based on the waste characteristics actually being discharged.

It is neither administratively nor economically feasible to measure the strength and charge each individual user of a sewerage system. Therefore the BSA established as a standard for domestic strength waste 250 mg/1 BOD, 250 mg/1 S.S. and 15.35 mg/1

Table 7. DISTRIBUTION OF BSA'S CONSTRUCTION COSTS BY DESIGN PARAMETERS

Facilities	Breakdown By Design Parameters				
	Flow	S.S.	BOD	P	Total
Modifications to Primary	$ -	$ 2,410,430	$ -	$ -	$ 2,410,430
Grit Disposal Facilities	-	170,660	-	-	170,660
Settled Wastewater Pump Station	7,698,680	-	-	-	7,698,680
Secondary Treatment Units	-	-	34,066,760	-	34,066.760
Blower Building	-	-	7,841,010	-	7,841,010
Final Settling Tanks	18,587,080	-	-	-	18,587,080
Chlorine Contact Tanks	5,750,810	-	-	-	5,750,810
Sludge Concentration Tanks	-	6,836,410	721,620	-	7,558,030
Sludge Disposal Facilities	-	17,610,860	1,858,920	1,808,670	21,278,450
Plant Outfall Sewer	656,600	-	-	-	656,600
Gate Chamber	331,440	-	-	-	331,440
Phosphate Removal Facilities	-	-	-	647,920	647,920
Preliminary Site Preparation	3,875,580	3,183,520	5,234,550	289,410	12,583,060
Roadways and Grading	1,109,790	911,610	1,498,940	82,870	3,603,210
New Electric Service	445,450	365,900	601,650	33,260	1,446,260
Heating and Ventilation	1,299,220	1,067,220	1,754,790	97,020	4,218,250
Administration Building	574,440	471,860	775,870	42,900	1,865,070
Miscellaneous Structures	1,612,970	1,324,940	2,178,550	120,450	5,236,910
Maintenance Shop	459,370	377,340	620,450	34,300	1,491,460
Technical and Legal Costs	7,255,840	5,960,150	9,800,090	541,830	23,557,910
Total	$49,657,270	$40,690,900	$66,953,200	$3,698,630	$161,000,000
Percent of Total	30.8%	25.3%	41.6%	2.3%	100%

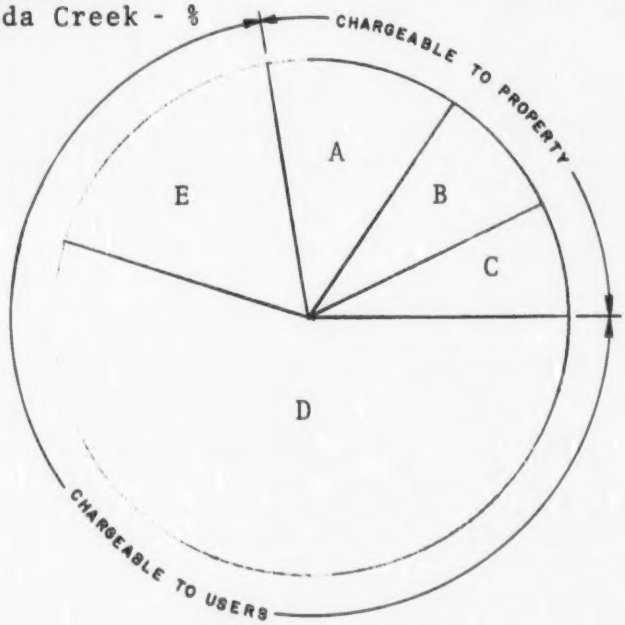
Table 8. DISTRIBUTION OF BSA'S O&M COSTS BY DESIGN PARAMETERS

Facilities	Breakdown By Design Parameters				
	Flow	S.S.	BOD	P	Total
Raw Wastewater Pump Station	$ 267,300	$ -	$ -	$ -	$ 267,300
Administration Building	162,100	139,000	139,000	$ 23,100	463,200
Grit Tank and Building	-	137,900	34,500	-	172,400
Sedimentation Tank and Building	-	98,500	98,500	-	197,000
Settled Wastewater Pump Station	409,700	-	-	4,100	413,800
Thickener and Filter Building	-	1,078,500	-	-	1,078,500
Incinerator Building	-	3,255,700	-	-	3,255,700
Blower Building	-	-	985,400	-	985,400
Chemical Building	1,905,900	79,400	-	1,985,300	3,970,600
Aeration Tank and Building	-	-	301,700	-	301,700
Final Tank and Building	-	92,400	92,400	-	184,800
Chlorine and Traveling Screen Building	235,600	54,300	72,500	-	362,400
Digester Control Building	16,400	131,500	16,400	-	164,300
Laboratory	-	93,800	147,400	26,800	268,000
Miscellaneous	573,400	573,400	573,400	191,200	1,911,400
Total	$3,570,400	$5,734,400	$2,461,200	$2,230,500	$13,996,500
Percent of Total	25.5%	41%	17.5%	16%	100%

Table 9. FIRST YEAR COST DISTRIBUTION - BSA SYSTEM

	Capital Cost Distribution					O&M Costs Distribution			
Parameter	A	B	C	D	E	B	C	D	E
BOD	27.7	2.0	2.2	43.1	25.0	3	3	60	34
S.S.	50.4	0.5	1.9	33.8	13.4	1	4	68	27
PO_4	34.7	-	13.6	25.8	25.9	0	21	40	39
Flow	5.6	10.4	11.1	59.9	13.0	11.0	11.8	63.5	13.7
Total	26.8	5.1	4.2	45.5	18.4	3.6	8.2	59.0	29.2

Chargeable to Property	Chargeable to Users
A. Future Use - %	D. Residential - %
B. Infiltration - %	E. Industrial - %
C. Scajaquada Creek - %	


CHARGEABLE TO PROPERTY
A
B
C
D
E
CHARGEABLE TO USERS

PO_4 to be used in establishing the basic sewer use charge. In addition, since high strength wastes are directly responsible for increased costs at the treatment plant, an extended charge or surcharge, over and above the basic sewer use charge, is levied against industries discharging wastes with strengths above the domestic waste standard.

The individual users of the Authority's facility have been broken down into four groups or classes as follows:

1. Domestic users residing in Buffalo
2. Industrial and commercial users in Buffalo
3. Domestic users outside of Buffalo
4. Industrial and commercial users outside of Buffalo

Each one of these groups that avails themselves of the services of the Sewer Authority will pay an identical basic unit rate for flow, BOD, S.S., and PO_4 concentrations. However, the O&M rate charged to the industrial users has been adjusted to take into account the additional administrative and engineering costs associated with the industrial waste program described in the previous sections.

Those special industrial rates for the first year O&M costs are:

Flow - \$0.017/1000 liters
BOD - \$0.090/kg.
S.S. - \$0.260/kg.
PO_4 - \$1.573/kg.

Based on the allocation of loading previously described and shown in Table 9, rate formulas were developed. There are two basic formulas, the first for computing the charge to the customers who discharge only domestic strength waste and the second for computing the rates charged to the industrial user. The domestic rate formula consists of two terms and is stated as thus:

Domestic Treatment Charge = Domestic User Charge + Property Charge

Each of the above terms contains a portion of the capital as well as the operating and maintenance costs.

The unit rates which apply to the above formula and all users for their share of the capital and O&M costs are as follows:

Rates For Capital Costs	Rates For O&M Costs
Flow - \$0.008/1000 liters	Flow - \$0.015/1000 liters
BOD - \$0.062/kg.	BOD - \$0.081/kg.
S.S. - \$0.031/kg.	S.S. - \$0.233/kg.
PO_4 - \$0.060/kg.	PO_4 - \$1.401/kg.

By using the domestic strength waste characteristics, all the unit rates for user charge can be expressed in terms of flow as follows:

Domestic User Charge = \$0.078/1000 liters
Industrial User Charge = \$0.106/1000 liters

Using the appropriate unit cost and the total assessed valuation of taxable property in the City of Buffalo, a property rate of \$2.32/\$1000 and \$1.75/\$1000 of assessed valuation for the capital and operations portions, respectively, was derived. It must be kept in mind that the formula equates charges in dollars to water consumption in thousands of liters.

The industrial rate formula is only an expanded version of the formula for domestic discharges just described. It consists of three basic terms, as follows:

Industrial Waste Treatment Charge = Domestic User Charge + Property Charge + Surcharge

The simple addition of the surcharge term makes the formula broadly applicable to all industries. When applying it to an industry that discharges only domestic strength waste, the last term just drops out and the formula becomes that of a domestic user. The surcharge portion, as stated below, provides an additional charge for each milligram of BOD, S.S., and PO_4 being discharged over and above what is considered domestic strength waste:

$$\text{Surcharge} = Q(0.152(\text{BOD} - 250) + 0.291(\text{SS} - 250) + 1.63(\text{PO}_4 - 15.35))$$

Where: Q = average annual discharge rate expressed in million liters/year

The determination of waste characteristics that would define an upper limit for domestic strength waste required a great deal of investigation. We reviewed ordinances from other municipalities across the country and it was found that the range of values adopted varied from 250 mg/l to 350 mg/l for BOD and suspended solids. Since the Buffalo metropolitan area has always had what would be considered a weak waste, it was deemed appropriate to use the low values. Therefore, 250 mg/l was selected to define the concentrations of BOD and suspended solids in Buffalo's domestic waste. The typical domestic concentrations of phosphorus was established at 15.35 mg/l as PO_4, or 5 mg/l as P. Shown in Table 10 is an example of the application of the industrial waste formula.

ECONOMICS OF REDUCING INCOMPATIBLE POLLUTANTS LOADING

In the Buffalo system, three areas were investigated for the pretreatment of incompatible pollutants: industrial pretreatment, municipal treatment, and dilution. It should be

Table 10. APPLICATION OF INDUSTRIAL WASTE RATE FORMULA

Formula: Industrial Waste Treatment Charge = $Q_{(1000\ \text{liters})}(0.106) + A(4.071)\ ) +$
$Q_{(MLY)}(0.152(BOD - 250) + 0.291(SS - 250) + 1.63(PO_4 - 15.35)\ )$
Where A = Assessed Valuation in \$1000

Industrial User

Let's assume Industry "X" has an assessed valuation of \$1,087,740. When surveyed, this company was found to discharge 8,703,200 lpd. BOD was measured at 384 mg/1, but SS and PO4 were below their respective limits of 250 mg/1 and 15.35 mg/1.

$Q_{(1000\ \text{liters})} = 3,176,679$

$Q_{(MLY)} = 3,177$

A = \$1,087.74

BOD = 384

Applying the Industrial Rate Formula:

Sewage Treatment Charge = 3,176,679(0.106) + \$1,087.740(4.071) +
3,177(0.152)(384 - 250)

Sewage Treatment Charge = \$405,860

stressed that the results of these investigations apply specifically to Buffalo and other systems completing the same analysis could have different results.

Pretreatment vs. Joint Treatment

At the present time, EPA's regulations governing industrial discharges into POTWs has not been finalized. Therefore, Buffalo's sewer regulations were used to determine which industries would require pretreatment. A review of the IWS's results produced a total of 30 industries that would require substantial pretreatment of heavy metals before discharge to Buffalo's system. It is anticipated that those industries which have waste characteristics only slightly in excess of the limits established by the regulations, will make in-plant or product line changes to meet the new discharge limits. With the exception of one industry, the method proposed for pretreatment was single stage lime precipitation. It was anticipated that the remaining industry would meet the limitations required by the sewer regulations by increasing the efficiency of its present clarification process.

The minimum total capital cost required to meet the new discharge limits was approximately 4.5 million dollars. Table 11, Cost of Pretreatment Facilities by SIC Category, shows the breakdown for the industries affected by SIC category. Approximately half of the four million dollars will be used for the pretreatment of discharges from plating processes. In addition to 12 electroplating industries, Buffalo has four industries in the Motor Vehicle Parts category whose pretreatment requirements are primarily a result of captive plating operations.

Equipment costs were based on the data presented in the Electroplating Point Source Category.[10] Labor, chemicals and sludge disposal costs were based on the rates being charged in the Buffalo area for 1974. Land costs were not included in these estimates, and process discharges were segregated where possible, to reduce the quantity of wastewater requiring treatment.

The potential reductions in surcharge levies were not taken into consideration in the cost estimates since the reduction will vary from industry to industry depending on the magnitude of the surchargeable parameters being discharged.

An alternative to having industries pretreat their waste individually would be to expand BSA's proposed treatment plant to provide the required treatment for incompatible pollutants.

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[10] Common and Precious Metals Segment of the Electroplating Point Source Category. EPA-440/1-75/040. April 1975. p153-179.

Table 11. COST OF PRETREATMENT FACILITIES BY SIC CATEGORY

SIC Category	# of Industries	Total Capital Cost	Total Annual Cost
Converted Paper Prod. (2649)	1	$ 0	$ 15,400
Cylic Crudes (2865)	1	0	1,300
Pottery Products (3269)	1	84,580	53,000
Steel Wire (3315)	1	310,000	188,200
Copper Rolling (3351)	1	657,140	296,900
Hand and Edge Tools (3423)	1	292,790	145,200
Plating (3471)	12	1,010,280	719,000
Steel Springs (3493)	1	50,850	23,900
Refrigeration Equipment (3585)	1	80,450	62,500
Motor Vehicle Parts (3714)	4	1,064,500	558,400
Industrial Supplies (5085)	3	147,280	66,100
Industrial Laundries (7218)	3	267,480	140,700
Totals	30	$3,965,350	$2,270,600

For industry to have all pretreatment requirements waived, the BSA would have to remove the same quantity of pollutants as would be achieved by the sum of individual industry pretreatment facilities. Table 12, below, shows the quantity of heavy metals that would have to be removed, the projected plant influent, and the required effluent quality.

Table 12. REQUIREMENTS FOR MUNICIPAL HEAVY METAL TREATMENT

Parameter	Kg/day Removed	Calculated Influent mg/l	Required Effluent mg/l
Cadmium	2.5	0.008	0.004
Chromium	100.0	0.254	0.104
Copper	104.0	0.198	0.041
Lead	19.3	0.044	0.015
Nickel	40.5	0.096	0.035
Zinc	205.0	0.514	0.207

The ability of a municipality to meet these required effluent limits without using advanced treatment methods is very questionable; however, some industrial treatment plants have reached these low levels for soluble chromium, copper, nickel and zinc by using chemical precipitation.[11] The cadmium and lead limits required effluent concentrations far below what could be expected by chemical precipitation.

For the purposes of comparing costs, it was assumed that chemical precipitation could remove the required quantities of heavy metals. Any advanced treatment processes that may be required would result in an even higher cost for heavy metal treatment at the BSA plant. The Buffalo Sewer Authority would most likely use a tertiary system to achieve the necessary removals since the organic portion of Buffalo's influent is already weak, a further reduction before biological treatment would not be desired. Therefore, it was assumed that a two-stage tertiary lime treatment system would be employed. Costs from The Guide to the Selection of Cost Effective Wastewater Treatment Systems[12], adjusted by a factor of 2 as per An Analysis of Construction Cost Experience For Wastewater Treatment Plants[13], was used for establishing the capital costs shown in Table 13.

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[11] Metal Finishing Segment of the Electroplating Point Source Category. EPA-440/1-75-040-a. April 1975. Table 24. p100.

[12] A Guide to the Selection of Cost Effective Wastewater Treatment Systems. EPA 430/9-75-002. July 1975. pB-1.

[13] An Analysis of Construction Cost Experience for Wastewater Treatment Plants. EPA 430/9-76-002. February 1976. p44.

Table 13. TERTIARY TWO-STAGE LIME TREATMENT COSTS

Description	Costs
Capital Cost	$21,900,000
Annual Cost	
Amortized Capital	2,334,900
Labor	341,200
Maintenance, Power and Heat	175,900
Chemicals	6,575,300
Savings in Phosphate Removal	- 2,520,100
Total Annual Cost	6,907,200

Assumptions

10% interest
30 year amortization
400 mg/1 lime dosage

The costs for a municipal treatment of heavy metals as shown above, would be approximately three times what the total cost would be for individual industrial pretreatment. The large dilution the industrial waste receives in Buffalo's system and resulting quantities of chemicals required, make it uneconomical for the BSA to attempt treatment. If advanced treatment methods should be required, then this would result in an even greater economic favorability for individual industrial pretreatment facilities.

Even though the BSA has an anti-dilution clause in its Sewer Use Regulations (Section VI), a concentration based discharge criteria creates the potential for industry to dilute its waste streams prior to discharge to avoid the need for pretreatment.

Pretreatment vs Dilution

In evaluating the economics of dilution versus pretreatment it was found that many of the industries requiring pretreatment do not have surchargeable pollutant loadings and would therefore only be required to pay the domestic rate for their discharges to the sewerage system. Figure 8, Electroplating Annual Costs for Meeting Effluent Limitations, was developed to show the potential for using dilution as a method for pretreating incompatible pollutants. The unit costs for pretreatment were adopted from the electroplater's (SIC 3471) cost estimates as previously discussed, using a minimum pretreatment plant size of 6000 1/hr. The costs for using dilution included the domestic rate of $0.106/1000 liters and an average cost for water of $0.224/1000 liters.

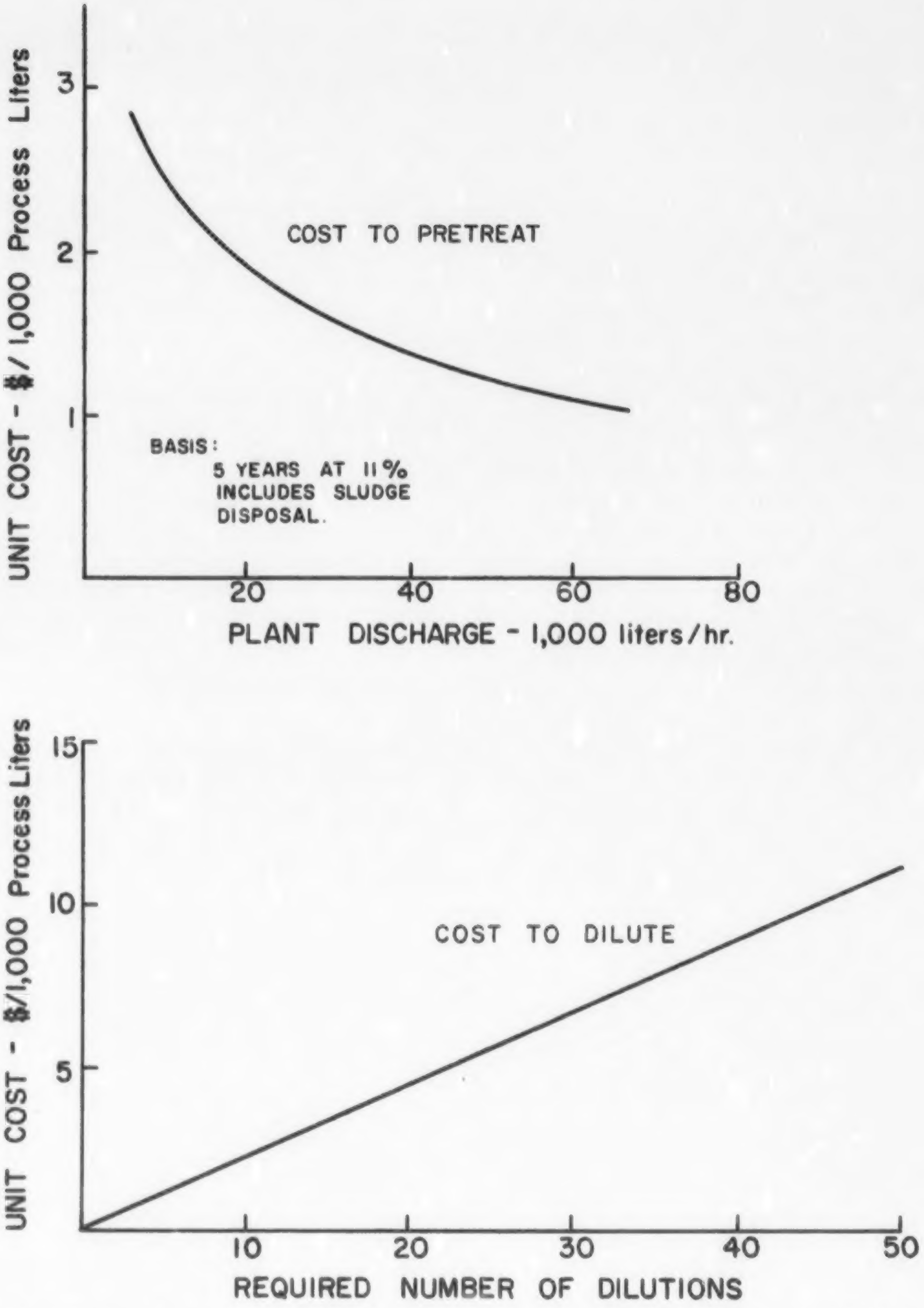

Figure 8 - Electroplaters Annual Cost Options For Meeting Effluent Limitations

There may be an economic incentive for some industries to use dilution as opposed to pretreatment. For example, an industry with a copper discharge 3.2 mg/1, presently would have to meet a discharge limit of 0.4 mg/1 under the BSA Sewer Regulations. This industry would require 8 dilutions to reduce the 3.2 mg/1 of copper to 0.4 mg/1 at a cost of $1.79/1000 process liters. Pretreatment would be cost effective if the industry's discharge rate was 30,000 1/hr. since the cost of pretreatment would be $1.60/1000 process liters. However, if the industry's discharge rate was 20,000 1/hr., the cost of pretreatment would then be $1.92/1000 process liters and dilution would be cost effective. This clearly indicates that the cost effectiveness of dilution versus pretreatment of incompatible pollutants is a function of the quantity of water necessary to reduce the pollutants concentration to an acceptable level and the size of the pretreatment plant that would be required. While this indicates an area of potential problems, the BSA will be able to recognize those industries using dilution by the sudden increase in their water consumption.

For the nine platers sampled, Table 14 shows their costs for using dilution and pretreatment to reduce their discharge metal concentrations to the Sewer Regulation's limits. For seven of the nine platers, the economics favored pretreatment with only two industries, 45-1 and 44-2, showing dilution to be more economical than pretreatment. In both these cases, the BSA will recognize the use of dilution by the large increase (five and seven fold, respectively) over their historical water consumption.

Table 14. ELECTROPLATER'S OPTIONS FOR MEETING EFFLUENT LIMITATIONS

Plant	Discharge 1000 1/hr	Dilution Required	Cost of Dilution $/1000 1	Cost of Pretreatment $/1000 1
44-28	19.5	15	3.25	1.96
20-16	18.0	36	7.99	1.67
9-7	45.5	19	4.13	1.29
27-10	4.9	43	9.48	3.05
45-1	20.2	5	1.02	1.90
20-12	11.2	217	48.20	2.36
32-1	12.8	30	6.70	2.23
16-16	10.9	13	2.97	2.38
44-2	18.8	7	1.60	1.95

ECONOMICS FOR REDUCING COMPATIBLE POLLUTANT LOADING

Surcharge vs Dilution

Some industries using the Buffalo treatment facilities will be paying substantial surcharges for excess loadings once the secondary treatment plant goes on stream. With the higher costs resulting from secondary treatment, surcharged industries may choose to reduce their loadings to the sewerage system by either installing pretreatment equipment or diluting their discharge to reduce concentration. As was previously mentioned, the use of dilution to reduce discharge concentrations is a violation of Buffalo's Sewer Use Regulation. However, as was the case for incompatible pollutants, there could be a potential for industries to use dilution as a method of pretreatment to reduce surcharges. Figure 9 was developed to evaluate this potential. Shown are the surcharge unit rates for various concentrations of BOD, SS, and PO_4, as well as unit costs for dilution. In all cases, the cost for using dilution far exceeded the cost for paying surcharges. This is illustrated in the examples shown in Table 15. This data and an effective public relations program should eliminate any attempt by industry to dilute its waste instead of paying the surcharge.

Table 15. COST OF DILUTION vs SURCHARGE - EXAMPLES

Industry "X"	Surcharge Rate
400 mg/l S.S.	$0.045/1000 l.
300 mg/l BOD	$0.008/1000 l.
10 mg/l PO_4	0
Total	$0.053/1000 l.
Dilution Rate	$0.132/1000 l.
Decision: Pay Surcharge	

Industry "Y"	Surcharge Rate
800 mg/l S.S.	$0.160/1000 l.
600 mg/l BOD	$0.052/1000 l.
38 mg/l PO_4	$0.040/1000 l.
Total	$0.252/1000 l.
Dilution Rate	$0.492/1000 l.
Decision: Pay Surcharge	

Industry "Z"	Surcharge Rate
800 mg/l S.S.	$0.160/1000 l.
1000 mg/l BOD	$0.101/1000 l.
38 mg/l PO_4	$0.040/1000 l.
Total	$0.301/1000 l.
Dilution Rate	$0.815/1000 l.
Decision: Pay Surcharge	

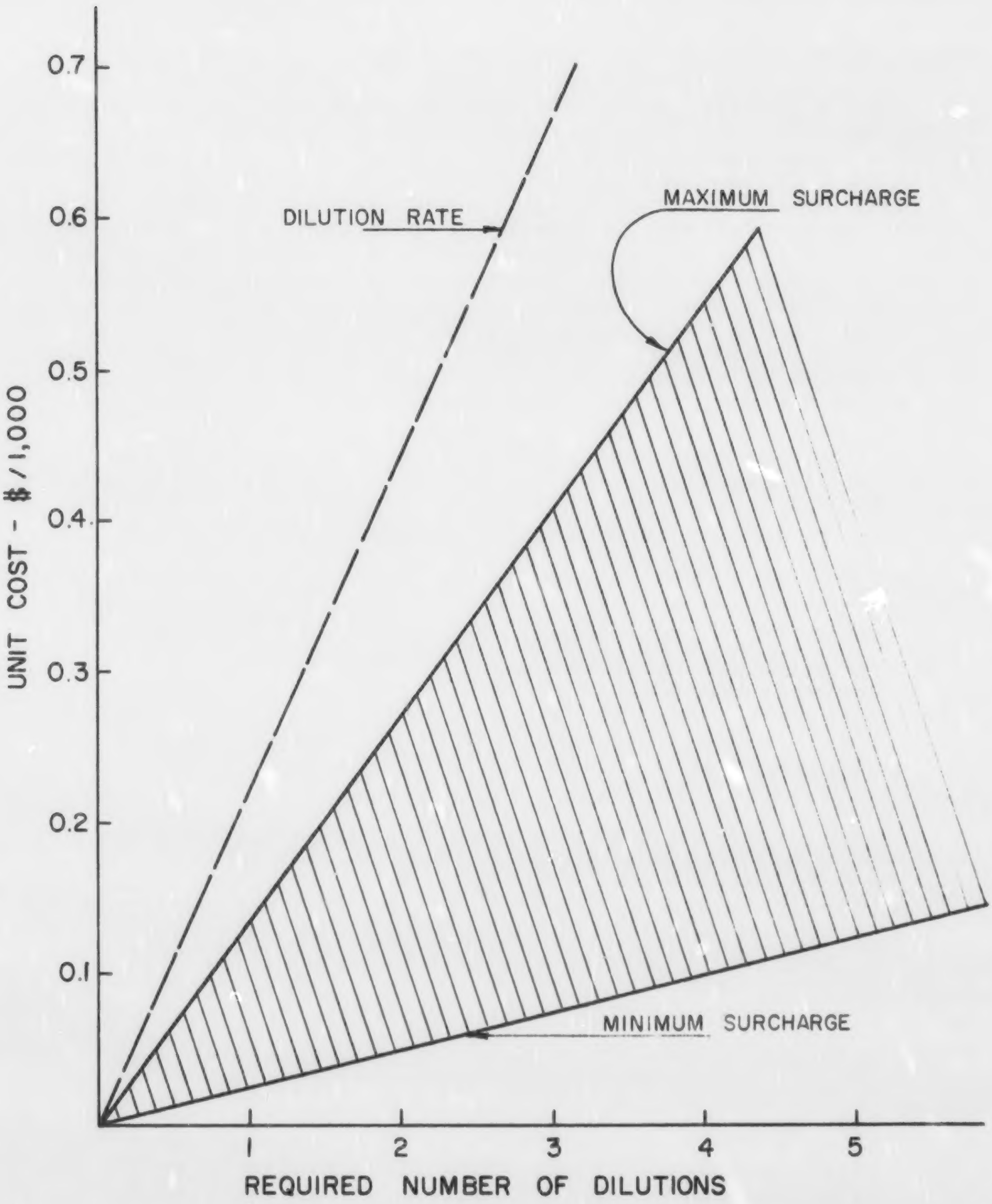

Figure 9 - Dilution Costs Vs Surcharges For The B.S.A. System

Surcharge vs Pretreatment

Because industries have such varied product lines and waste characteristics, even within the same SIC category, the evaluation of the economics for pretreatment versus payment of surcharges would be done on an individual basis. Therefore, Figure 10 was developed only as a guide to indicate whether pretreatment of compatible pollutants would be economically justified before discharge to a municipal system. Costs were developed for three unit processes: clarification, chemical precipitation, and biological treatment. The costs and process efficiencies were obtained from the manufacturers of the various types of equipment. Amortization of the capital costs was based on a five-year payback at an 11% interest rate. It must be kept in mind that on a case by case basis, the economics may favor a different type of process or any combination thereof. The removals that might be experienced from these processes are shown in Table 16.

Table 16. REDUCTIONS FROM PRETREATMENT

Process	Percent Removal		
	BOD	SS	PO_4
Clarification	30	45	5
Chemical Treatment	60	80	80
Biological Treatment	85	85	10

The removals shown in Table 16 are a generalization, and it should be pointed out that in practice, the removals shown above may vary depending upon the specific waste characteristics. For example, an industry having a high concentration of S.S. in its discharge, the majority of which is settlable, will undoubtedly obtain better than 45% removal with a properly sized clarifier.

In general, clarification was the least expensive method for pretreatment; however, it is obvious that if an industry is only surcharged for BOD, unless the waste stream contains a larger percentage of insoluble BOD, clarification may not be cost effective, versus payment of the surcharge. Therefore, before designing a pretreatment facility, an industry should thoroughly investigate all possible alternatives including the possibility of segregating sources of its waste streams to reduce flow quantities.

In order to obtain an idea of the relative costs of pretreatment versus the cost of BSA's surcharges, the discharges from three specific industries were evaluated. The surcharges and waste characteristics for these industries can be found in Table 17.

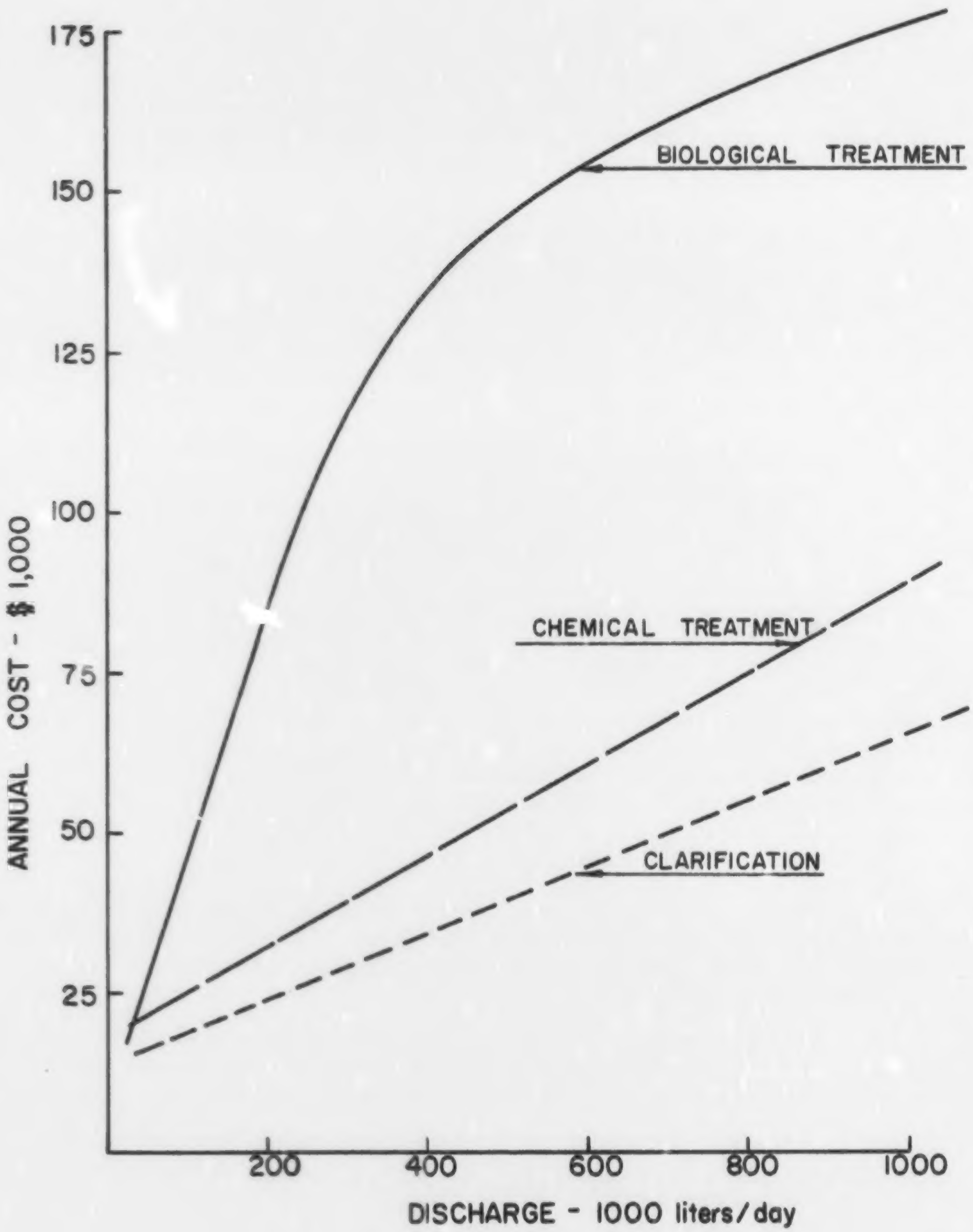

Figure 10 - Annual Cost For Pretreatment Of Compatable Pollutants

NOTE: Capital Costs Obtained From Vendors Quotos

Table 17. EXAMPLE OF INDUSTRIAL SURCHARGES

Industry	Flow-Megaliters	BOD-mg/l	SS-mg/l	PO_4-mg/l
29-3 Converted Paper Surcharge	0.341	191 None	5486 $189,347	3.1 None
17-9 Fats and Oils Surcharge	1.540	908 $56,238	215 None	5.23 None
37-7 Sausages Surcharge	0.901	1990 $59,577	423 $11,332	562.3 $201,135

Looking first at Industry 29-3, the computed surcharge amounts to $189,347 per year as a result of the discharge of excess suspended solids. The installation of a clarification pretreatment unit would normally result in a 45% removal of the S.S.; however, data from the IWS indicated that clarification with the addition of polyelectrolite would remove enough S.S. to eliminate any surcharge. From Figure 10, the annual cost for clarification was approximately $30,000 and $7,000 for polyelectrolite addition, for a total annual cost of $37,000. Comparing this cost to Industry 29-3's surcharge in Table 15, shows that the use of pretreatment would result in a savings of $152,000 per year. For Industry 27-9, the economics favor the payment of the surcharge. In this case, the surcharge of $56,238 per year was less than the annual cost of installing clarification equipment which would only remove 30% of the BOD. Industry 37-7's waste discharge is surchargeable in all three categories resulting in a total surcharge of $272,040 per year. Pretreatment consisting of chemical precipitation would eliminate the surcharges for S.S. and PO_4 at a cost of $80,000 per year and the BOD surcharge would be reduced to $18,695. In this case, the installation of pretreatment will result in an annual savings to the industry of $173,345.

As shown, pretreatment of compatible pollutants can be economical for some of the industries. Again, each industry should be evaluated individually to determine the economics of pretreatment.

SECTION 8

COMBINED DOMESTIC AND INDUSTRIAL WASTE TREATMENT

INTRODUCTION

Combined treatment of industrial and domestic type wastes is often economically beneficial to the treatment agency and its users. However, as discussed in earlier sections, the discharge of industrial wastes into POTWs must be controlled so that the treatment plant can function at maximum efficiency with a minimum of cost.

POTWs accepting industrial wastes, especially those upgrading from primary treatment or those who have not yet received their NPDES permits must carefully evaluate their entire sewerage system before establishing industrial waste control policies. One significant area which should be examined is the operation and efficiency of the treatment plant. Treatment plants are designed and operated to remove specific pollutants, such as BOD and S.S. However, other pollutants may also be removed, to a lesser degree, in the treatment processes. The removals of insoluble phosphorus and metals in the clarifiers are typical examples of incidental removals. It would be beneficial to its industrial users if the treatment agency could reduce the pretreatment requirements by taking advantage of these incidental removals. However, the treatment agency must keep in mind that when incidental removals are achieved the decrease in pollutant levels in the liquid or effluent stream will result in an increase in the pollutant level in the sludges, thus possibly limiting their sludge disposal options. Therefore, the treatment agency must carefully evaluate their specific conditions to insure that the benefits gained are greater than the problems that may arise. The Environmental Protection Agency has provided for the allowance of a credit to industries for incidental removals. This policy is described in the following quotation from Section 128.133 of 40 CFR 128:

> "...Provided, that, if the publicly owned treatment works which receives the pollutants is committed, in its NPDES permit, to remove a specified percentage of any incompatible pollutant, the pretreatment standard applicable to users of such treatment

works shall be correspondingly reduced for that pollutant..."[14]

DESCRIPTION OF PILOT PLANT INVESTIGATIONS

Since the upgrading of Buffalo's primary treatment plant to secondary treatment is only in the initial stages of construction, a 95,000 liter/day pilot study was conducted to evaluate the effects the industrial users will have on the treatment processes. This investigation was primarily concerned with three areas: defining the metal concentrations in the sludges, exploring the possibilities of credits for the incidental removals of heavy metals, and to compile background data for finalizing Buffalo's NPDES permit.

So that the data generated by the pilot study would have the maximum applicability to the Buffalo sewerage system, a package treatment plant was modified to simulate as closely as possible the characteristics and operation of Buffalo's new plant. In order to incorporate the daily fluctuations in waste strength and volume normally experienced in a full scale plant, the influent to the pilot plant was varied in direct proportion to the flow received at the Authority's primary plant. As shown in Figure 11, the process piloted was a conventional activated sludge with the addition of the chemical precipitation of phosphorus in the aeration tank.

It took 43 days for the process to reach a steady state condition. The pilot plant was then monitored for a period of 30 days to trace the movement of heavy metals through the system. This was accomplished by daily analyzing flow proportion samples of the influent and secondary effluent. The primary effluent, waste primary, and waste secondary sludge were sampled daily and weekly composites analyzed for heavy metals.

During the beginning of the acclimation period, the food/mass ratio was quite high due to the low quantities of mixed liquor volatile suspended solids. This was attributed to the slow acclimation of the biomass to the wastewater. The extended period of time required for acclimation was a result of the unusually wet weather Buffalo was experiencing. During the operation of the pilot plant, precipitation fell approximately 50% of the time. Since 96% of the Buffalo's collection system is combined, the dilution from the storm water inflow created an extremely weak waste. During this start-up period, the influent BOD varied from 19.5 mg/l to a high of 97.5 mg/l. In order to provide additional food for the biomass during this period, the primary clarifier was by-passed and the influent was fed directly into the aeration tank. As the plant became acclimated,

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[14] Pretreatment Standards, Part 128. Federal Register. Vol. 38. No. 215. EPA. November 8, 1973. p30984.

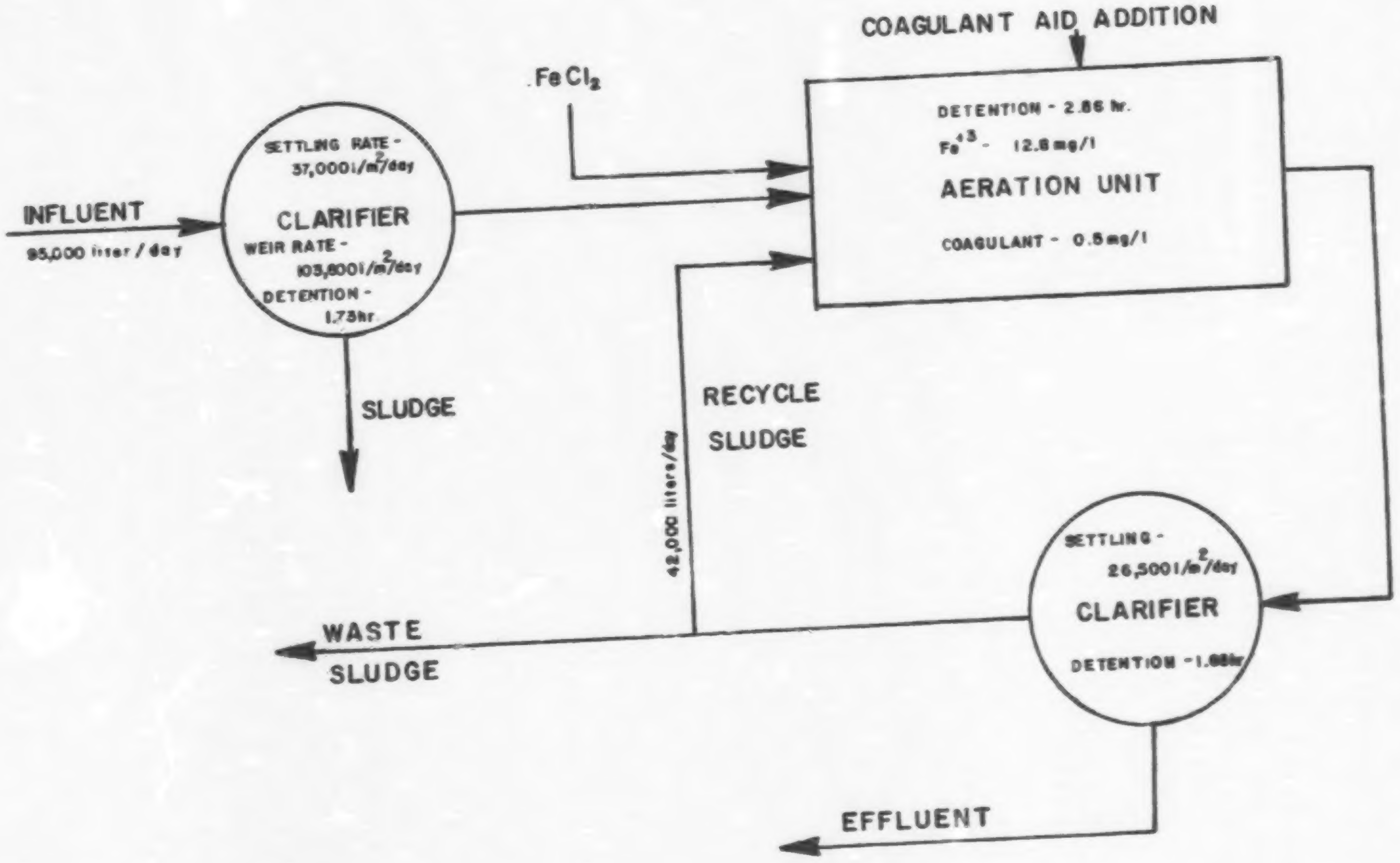

COAGULANT AID ADDITION
.FeCl2
SETTLING RATE - 37,000 l/m2/day
CLARIFIER
WEIR RATE - 103,800 l/m2/day
DETENTION - 1.73hr
INFLUENT
95,000 liter / day
SLUDGE
DETENTION - 2.86 hr.
Fe+3 - 12.8 mg/l
AERATION UNIT
COAGULANT - 0.5 mg/l
RECYCLE SLUDGE
42,000 liters/day
SETTLING - 26,500 l/m2/day
CLARIFIER
DETENTION - 1.08hr
WASTE SLUDGE
EFFLUENT

Figure 11: B.S.A'S ACTIVATED SLUDGE PILOT FLOW DIAGRAM

the primary clarifier was put back in operation. Additional quantities of secondary sludge were recycled to the aeration tank to compensate for the weak influent.

New York State standards require that the concentration of phosphorus in a POTW's effluent average 0.5 mg/l with a maximum concentration not to exceed 1 mg/l. Ferric chloride ($FeCl_3$) was used to achieve the required phosphorus removals. Commercial $FeCl_3$ diluted to the proper concentration was fed by means of a metering pump to the head of the aeration tank. By locating the $FeCl_3$ addition at this point, proper mixing of the $FeCl_3$ and mixed liquor was insured. To allow for the pilot plant to stabolize, the addition of $FeCl_3$ was started one week prior to the heavy metal monitoring of the system.

On the 18th of November, monitoring of trace quantities of heavy metals began. The pilot plant was well acclimated and operated efficiently in spite of the lower than desired level of mixed liquor suspended solids.

In the first two weeks of the monitoring period, the suspended solid removals were below the desired level. It was felt that this was caused by a pin point floc that is created by the vigorous mixing occuring in the aeration tank. During the third week of the monitoring period, an attempt was made to correct this condition by changing the single feed location of the $FeCl_3$ to two points. This did increase the suspended solids capture but did not bring it up to the desired level. In the fourth week, the second $FeCl_3$ point was replaced with a polymer addition. This resulted in a greater suspended solids capture than was previously achieved, however, it was still below the desired removals.

DISCUSSION OF RESULTS

The level of treatment achieved by the pilot plant was slightly lower than that which will be required of Buffalo's secondary treatment plant. This was attributed to the low influent concentrations and poor performance of the secondary clarifier. It is expected that the full scale plant will average higher BOD and suspended solids removals since the treatment units are more precisely designed. A summary of the operational data can be found in the appendix.

The monitoring of toxics in the pilot plant, was conducted to indicate the removals that could be expected and the quantity of metals which build up in the sludges. While their determination was beyond the scope of the project, some comments on the possible removal mechanisms are pertinent for interpreting the data. Many of the metal's removals varied with influent concentrations. However, the large degree of variation in the removal indicate that other factors, such as complexing ligands, ionic strength and volatile suspended solids concentrations, affect the removals obtained. Adsorption of metals onto the solid phase and the removal of insoluble metals by settling probably accounted for the majority of the removals obtained. The contribution from metal precipitation was thought to be minimal due to the pH and relatively low metal concentrations in the influent.

To establish the criteria that would enable the BSA to predict the metal removals that could be expected and the metal concentrations that would be found in the sludges, balances were performed on the pilot plant as shown in Table 18. The background data for these balances, Pilot Sludge Characteristics and Daily Trace Element Concentrations can be found in the appendix. Due to weekly instead of daily sludge analysis and also to periodic freezing and leakage of the waste sludge lines, the results on the primary and secondary unit balances were not as accurate as the balances around the entire pilot plant, since the influent and effluent streams were analyzed daily. Based on the results of the balances, the heavy metal concentrations for the pilot plant's effluent and waste sludge streams were projected as shown in Table 19. To investigate the effects these metal concentrations will have on the BSA sludge disposal options, projections were made for sludge concentrated to 20% solids and for ash. This will be discussed in more detail later in this section.

The balances for the various metals indicated that better than 60% removals could be expected for lead, chromium and copper. Less, but significant, removals were also obtained for zinc and cadmium, while nickel and cyanide exhibited insignificnat removals. This information, together with the data previously developed for the sewerage system, enabled the BSA to develop sewer use regulations which suits its system. For example, the discharge limits for lead need not be as stringent as those for nickel since a larger percentage of lead is removed at the Authority's plant. Other investigations across the country have also shown that significant metal removals could be obtained by municipal treatment plants.[15,16,17] Based on actual removals being obtained by their treatment plant, the municipality of Metropolitan Seattle has already requested that consideration should be given to these removals in determining Metro's NPDES permit. The removals achieved during Buffalo's pilot study were lower

[15] Cheng M.H, Patterson J.W., and Minear R.A. Heavy Metals Uptake by Activated Sludge. WPCF Journal. Vol. 47. No. 2. Feb. 1975. p362-276.

[16] Brunner C.A. EPA Correspondence to John T. Rhett. Removal Capability of Wastewater Treatment Processes for Metals and Other Pollutants. 8/20/74. p1-12.

[17] Esmond S.E., Petrosek A. Dallas Water Utilities Dept. Removal of Heavy Metals by Wastewater Treatment Plants. March 1973. p1-16.

Table 18. TRACE ELEMENT BALANCES ON BSA'S PILOT PLANT

Description	Weekly Quantities - Kg/day x 10^{-4}					Study Period
	Week 1	Week 2	Week 3	Week 4	Week 5	
		Cadmium Balance				
Influent Sewage	78.58	155.22	139.81	64.33	90.09	528.03
Primary Effluent	384.13	145.33	148.41	65.29	86.98	830.14
Primary Sludge	0.15	0.59	1.41	1.68	1.20	11.06
% Removed in Primary	increase	6.40	increase	increase	3.45	increase
Secondary Effluent	98.16	71.34	74.41	47.60	44.81	336.31
Secondary Sludge	-	40.86	10.90	8.63	6.81	67.20
% Removed in Secondary	74.50	50.90	49.90	27.10	48.50	59.50
Overall % Accounted For	125.10	73.00	62.00	90.00	59.00	78.50
Overall % Removed	increase	54.00	47.00	26.00	50.00	36.30
		Chromium Balance				
Influent Sewage	1096.8	1094.9	2049.6	885.6	1062.7	6189.6
Primary Effluent	853.3	1211.0	2091.4	1044.6	1381.5	6581.8
Primary Sludge	12.2	10.3	27.1	23.4	15.9	88.9
% Removed in Primary	22.2	increase	increase	increase	increase	increase
Secondary Effluent	458.9	455.0	553.2	512.3	243.3	2222.7
Secondary Sludge	-	1024.2	294.6	219.3	143.5	1681.6
% Removed in Secondary	46.2	62.4	73.5	51.0	82.4	66.2
Overall % Accounted For	43.0	136.0	42.7	85.3	37.9	64.5
Overall % Removed	58.2	58.4	73.0	42.2	77.1	64.1
		Copper Balance				
Influent Sewage	561.5	715.7	1002.3	795.3	1038.8	4113.6
Primary Effluent	527.1	484.4	877.0	783.4	921.0	3592.9
Primary Sludge	0.0	4.3	17.9	18.9	16.5	57.6
% Removed in Primary	6.1	32.3	12.5	1.5	11.3	12.7
Secondary Effluent	406.3	275.8	274.5	261.7	332.1	1550.4
Secondary Sludge	-	653.8	384.9	397.4	136.7	1572.8
% Removed in Secondary	22.9	43.1	68.7	66.6	63.9	56.8
Overall % Accounted For	72.4	130.0	40.0	52.0	47.0	77.3
Overall % Removed	27.6	61.5	72.6	67.1	68.0	62.3

Table 18 continued. TRACE ELEMENT BALANCES ON BSA'S PILOT PLANT

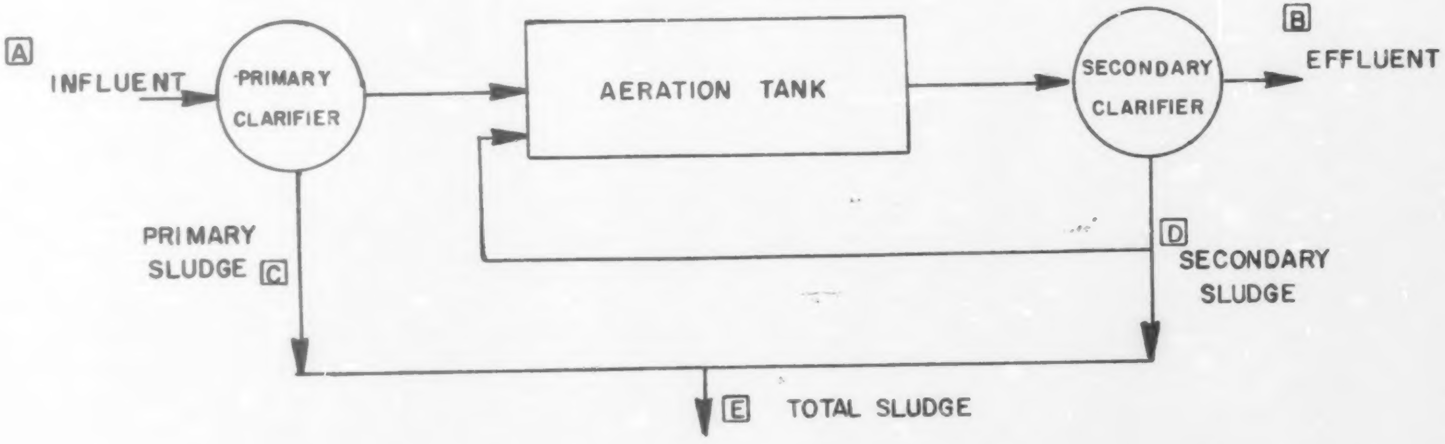
Description	Weekly Quantities - Kg/day x 10^{-4}					Study Period
	Week 1	Week 2	Week 3	Week 4	Week 5	
		Cyanide Balance				
Influent Sewage	282.6	205.5	408.4	291.7	222.7	1410.9
Primary Effluent	430.0	N.D.	1045.7	404.8	547.5	2428.0
Primary Sludge	3.4	4.6	3.5	3.5	3.1	18.1
% Removed in Primary	increase	100.0	increase	increase	increase	increase
Secondary Effluent	297.9	176.9	339.8	338.2	220.6	1373.4
Secondary Sludge	-	217.9	78.1	65.4	38.1	399.5
% Removed in Secondary	30.7	increase	67.5	16.5	59.7	43.4
Overall % Accounted For	106.6	194.4	103.2	139.6	117.6	126.9
Overall % Removed	increase	13.9	16.8	increase	0.9	2.7
		Lead Balance				
Influent Sewage	1036.8	326.7	726.6	546.7	524.2	3161.0
Primary Effluent	843.1	213.2	74.2	652.9	460.5	2243.9
Primary Sludge	2.7	5.7	22.2	35.1	23.8	89.5
% Removed in Primary	18.7	34.7	89.8	increase	12.2	29.0
Secondary Effluent	223.5	138.5	143.4	140.4	114.0	759.8
Secondary Sludge	-	517.6	173.0	250.6	215.2	1156.4
% Removed in Secondary	73.5	35.0	increase	78.5	75.2	66.1
Overall % Accounted For	21.8	202.6	46.6	77.9	67.3	63.5
Overall % Removed	78.4	57.6	80.3	74.3	78.3	76.0
		Mercury Balance				
Influent Sewage	20.700	2.000	N.D.	N.D.	N.D.	22.7
Primary Effluent	179.500	N.D.	20.20	N.D.	N.D.	199.7
Primary Sludge	0.018	0.018	0.14	0.059	N.D.	0.2
% Removed in Primary	increase	100.000	increase	-	-	increase
Secondary Effluent	37.600	7.230	N.D.	N.D.	N.D.	44.8
Secondary Sludge	-	1.500	0.77	78.500	N.D.	80.8
% Removed in Secondary	79.100	increase	100.00	-	-	77.6
Overall % Accounted For	181.700	437.400	Gain	Gain	-	554.2
Overall % Removed	increase	increase	-	-	-	increase

Table 18 continued. TRACE ELEMENT BALANCES ON BSA'S PILOT PLANT

Description	Weekly Quantities - Kg/day x 10^{-4}					Study Period
	Week 1	Week 2	Week 3	Week 4	Week 5	
		Nickel Balance				
Influent Sewage	291.7	258.5	26.0	608.3	398.7	1583.5
Primary Effluent	351.5	242.2	N.D.	522.3	358.2	1474.2
Primary Sludge	23.2	0.6	2.7	3.7	4.0	34.2
% Removed in Primary	increase	6.4	100.0	14.1	10.2	6.9
Secondary Effluent	291.4	226.7	8.1	563.1	314.6	1403.9
Secondary Sludge	-	81.7	21.8	31.3	46.8	181.6
% Removed in Secondary	17.1	6.4	increase	increase	12.2	4.8
Overall % Accounted For	107.9	119.4	125.4	98.3	91.7	102.3
Overall % Removed	0.1	12.4	68.9	7.4	21.1	11.3
		Zinc Balance				
Influent Sewage	5313.2	1532.2	242.6	1902.3	1494.0	10484.3
Primary Effluent	2356.8	1501.7	202.4	1697.4	1432.6	7190.9
Primary Sludge	30.5	10.6	4.4	62.0	4.9	112.4
% Removed in Primary	55.7	2.0	16.6	10.8	4.1	31.4
Secondary Effluent	2957.8	986.5	201.1	1026.1	783.2	5954.7
Secondary Sludge	-	762.7	49.5	357.3	241.5	1411.0
% Removed in Secondary	increase	34.3	0.6	39.6	45.3	17.2
Overall % Accounted For	56.2	114.9	105.1	76.0	68.9	71.3
Overall % Removed	44.3	35.6	17.1	46.1	47.6	43.2

Table 19. CHARACTERISTICS OF PILOT EXIT STREAMS - SUMMARY

Parameter	A	B		C		D		E_1-0.6% Solids		E_2-20% Solids		E_3-Ash
	Conc. mg/1	Conc. mg/1	% Rem.	Conc. mg/1	% Rem.	Conc. mg/1	% Rem.	Conc. mg/1	% Rem.	Conc. mg/1	Conc. mg/kg	Conc. mg/kg
Lead	0.099	0.025	76	8.78	6	7.64	70	7.72	76	360	2660	2660
Chromium	0.210	0.074	64	8.44	5	11.11	59	10.9	64	508	3760	3760
Copper	0.140	0.050	62	5.48	5	6.85	57	6.74	62	314	2325	2325
Zinc	0.340	0.200	43	14.80	4	9.32	39	9.77	43	455	3360	3360
Cadmium	0.018	0.011	36	0.45	2.5	0.44	33.5	0.44	36	20	150	150
Nickel	0.050	0.047	11	3.25	2	1.20	9	1.37	11	63	460	460
Cyanide	0.051	0.046	3	1.71	1	2.64	2	2.56	3	120	890	0


A
INFLUENT
PRIMARY CLARIFIER
AERATION TANK
SECONDARY CLARIFIER
B
EFFLUENT
PRIMARY SLUDGE C
D
SECONDARY SLUDGE
E TOTAL SLUDGE

than those reported by other investigators. This is probably due to the low influent concentrations in the Buffalo wastewater.

The policy of crediting the removals obtained at the POTWs in establishing discharge limits must be carefully considered in light of removal variability and potential limitations for sludge disposal. Considering that sludge treatment and disposal costs are typically 30% - 35% of a plant's annual costs, the metal concentrations in the sludge should be considered not only in developing the Sewer Use Regulations but also in the design of the plant. For example, if a POTW planned to dispose of its sludge as a soil conditioner, they would have to require more stringent discharge limits to insure that the metal levels would be low enough so as not to inhibit the plant's digestors and be acceptable for use as a soil conditioner. However, if incineration was to be the chosen method for sludge treatment, a higher metal content could be tolerated. The controlling limitations would be those imposed by regulations for the disposal of ash and water quality.

VARIABILITY OF RESULTS

The influent concentrations and the removal efficiencies exhibited by the pilot plant had a high degree of variability. This variability should be taken into account when establishing discharge limits or determining credits.

Summarized in Table 20 below, are the average removals, and the influent concentrations with their respective standard deviations for the trace elements measured during the study. The average removals shown below differ slightly from those presented in Table 19. The reason for this is that the removals shown below were calculated from concentrations and do not include a factor for the variations experienced in flow. Whereas the removals shown in Table 20 account for these flow variations.

Table 20. AVERAGE INFLUENT CONC. & REMOVALS FOR PILOT OPERATION

Parameter	Daily Removals - %		Influent Conc.	
	Avg.*	Std. Deviation	Avg.- mg/l	Std. Deviation
Lead	73.8	29.9	0.099	0.087
Copper	61.0	23.0	0.137	0.075
Chromium	62.2	27.4	0.208	0.131
Zinc	41.3	21.6	0.337	0.311
Cadmium	37.7	26.4	0.018	0.015
Cyanide	6.5	18.6	0.046	0.024
Nickel	11.0	17.8	0.050	0.044

*Does not include a factor for flow variations.

From the daily graphs of metals influent concentrations and removals, see Appendix, it was obvious that one of the major variables effecting the removals was the specific metal concentration in the influent. It was also found that there were specific concentration limits, below which, factors other than influent concentration controlled the removals obtained. For example, Figure C-7, shows the daily variations in zinc removals and influent concentrations. Between December 9 and December 20, the removal efficiencies seem to be directly related to the influent concentrations. However, between December 1 and December 8, the influent concentrations were low and fairly constant while the removals varied from 0 to a high of 71.4 percent removed. Obviously, some factor other than the variation in concentrations, was affecting the removals obtained.

IMPACT OF REGULATIONS ON THE BSA'S COMBINED TREATMENT

The BSA, in establishing its industrial waste control program, evaluated both Federal and New York State's pretreatment requirements. It was found that there were no federal requirements presently in effect and those that were proposed were being re-evaluated. New York State's published requirements are of a general nature with the specifics being established on a case by case basis, depending upon the water quality standards for the POTWs receiving stream and their method of treatment. Since there were no firm guidelines available from either of the two regulator agencies, the BSA established what they considered stringent discharge limits for specific incompatible pollutants and submitted them to EPA and New York State for approval. Approval was obtained from EPA. However, New York State required that the discharge limits for chromium (hexavalent), copper, zinc, cadmium, arsenic and cyanide be lowered. While the discharge limits were revised and incorporated into the Sewer Use Regulations (Section VI), the BSA is presently working with New York State to re-evaluate their imposed discharge limits in order to reduce the pretreatment loading on industry. Due to today's poor economic conditions existing in the Buffalo area which has already been hard hit by plant closures, the BSA feels that their discharge limits should not only be environmentally sound but also have some relative stringency as the discharge limits for other areas of the country. The importance of having uniform standards was illustrated in the BSA's public meetings when the point was brought up by a few industries that the discharge limits being imposed by BSA are more stringent than those in some other areas of the country. This could provide the additional incentive for these industries to relocate all or portions of their plant operations in other areas of the country having less stringent regulations. One of the methods the BSA would like to use to reduce industry's pretreatment requirements is to incorporate into its discharge limits, a credit for removals achieved at the BSA plant. This would effectively raise the discharge limits while still maintaining the same discharge quality.

While the control of discharges of pollutants in toxic or inhibitory quantities from industry is important, industry is also an important contributor of compatible pollutants. Since the BSA's new secondary treatment plant was designed for joint treatment, the industrial contribution is necessary for efficient operation. In addition to being a significant flow contributor,(17.7%) industry contributes approximately 39% of the phosphorus, 34% of the BOD, and 27% of the S.S. loadings. As discussed in Section 7, industry will pay for the expanded portions of the treatment facility required to treat its contribution at no additional cost to the public. The cost to each user will be equitable since the charges are based on each user's waste characteristics. Practices such as separate rates for industry and volume discounts will not be allowed once the new treatment plant goes on stream.

In the near future, two factors will affect the characteristics of the industrial contributions to the BSA system. The adoption and enforcement of the sewer regulations will reduce the amounts of potentially toxic or inhibitory contaminents entering the Sewer Authority's system. In addition, once industries install pretreatment to meet the requirements, reductions would also occur for BOD, suspended solids and phosphorus loadings. A rough estimate of those reductions would be 1.5% of the BOD, 9.9% of S.S., and 4.5% of phosphorus loadings. The second factor affecting the characteristics of the industrial contributions will be the surcharge levels. The cost recovery system requires an additional charge be paid by industries discharging wastes with concentrations in excess of 250 mg/l of BOD and S.S. and 5 mg/l of phosphorus. Industries that will be levied high surcharges will probably investigate pretreating their wastewater prior to discharge into the BSA's system. Estimates of those that may install pretreatment cannot realistically be made at this time since other factors such as the availability of land and money affect the ability of any given industry to install the necessary equipment. A more detailed discussion of the economics of pretreatment vs surcharge can be found in Section 7. The quantities of BOD, S.S. and phosphorus contributed at surchargeable levels is substantial. Summarized below, are the loadings and percent of the total plant loadings, contributed by wastewater having strenghts exceeding the limits previously described for surcharge.

Table 21. SURCHARGEABLE LOADINGS IN THE BSA SYSTEM

Parameter	Surchargeable Loading kg/day	% of Plant Loading
BOD	12,530	10.8
S.S.	4,222	3.1
P	289	13.3

It is expected that these quantities will be reduced by inplant control measures, product changes, and pretreatment.

In some instances, the economics may favor a combination of a direct discharge to waterways and a discharge to a municipal sewerage system. With the segregation of process stream, an industry could discharge its pretreated incompatible pollutants to a waterway and only discharge its compatible pollutants to the municipal system, thereby lowering their sewer use charges. Since this study was initiated, one industry has entered Buffalo's system rather than pretreat for direct discharge. In addition, two other industries, a petroleum refiner and an inorganic chemical plant, are negotiating to redirect the compatible pollutant portions of their waste discharged to the BSA's system. In the surrounding area, other industries are also expressing interest in entering POTWs.

It is difficult to predict, beyond a few years, what the impact of the Industrial Wastes Characterisitcs will have on the treatment plant since it is not known what the future requirements will be. The new plant was designed to include the industrial portion, their inclusion in the future would remain an important factor from both a cost distribution and treatment efficiency point of view.

One of the immediate impacts of the enactment and enforcement of the BSA Sewer Regulations will be a reduction in the quantity of potentially toxic material received at the treatment plant.

The primary toxic problem in the Buffalo system can be categorized as "heavy metals". Another problem area, minor in nature, was the industrial contributions of phenol, however, industries contacted indicated this problem could largely be solved through better in-plant control measures. Insecticides and pesticides were not found in measureable quantities at the treatment works nor are they produced nor used to any great extent in the areas served by the BSA system.

Table A-1, Characteristics of SIC Categories Summary, indicated twelve categories that contribute substantial quantities of heavy metals. The 12 categories consisted of 30 industries which will require pretreatment. For 30 of the 30 industries requiring pretreatment, the method used in this analysis was lime precipitation with CN destruction and Cr reduction, where required.

It should be recognized that alternative methods may be employed to achieve the necessary reductions. The process used for these determinations was single stage lime precipitation with polymer addition which would generate 5% solids and could be dewatered to a 20% cake. The assumption was made with some reservation, that this unit process would produce an effluent meeting the Sewer Regulation's limits. The remaining industry can meet the limits prescribed by the sewer regulations by clarification. The quantities of metals that would be removed by this type of pretreatment were totalized to obtain an estimate of the kilograms per day of metals removed by pretreatment. Each metal the total quantity removed, was then contrasted against that metal's present loading at the Authority's Bird Island Treatment plant to show the reductions which could be obtained by pretreatment. Summarized in the following table are the findings for each of the parameters investigated.

Table 22. SUMMARIZED SLUDGE QUANTITIES FROM PRETREATMENT

Parameter	Present Ind. Contribution mg/l	Removed* Kg/day	Resulting Influent mg/l	% of BSA's Plant Load.
Copper	0.198	104.0	0.04	79.0
Lead	0.044	19.3	0.01	66.3
Nickel	0.096	40.5	0.04	63.4
Zinc	0.514	205.0	0.21	60.1
Chromium	0.254	100.0	0.11	59.1
Cadmium	0.008	2.5	0.004	48.1
Mercury	0.0049	0.04	0.0048	1.3

*Quantities removed from plant influent if industries pretreated to the existing discharge limits.

With the exception of mercury, pretreatment will substantially reduce the metal loadings received at the Bird Island Treatment Plant. In the case of mercury, only 1.3% reduction in the treatment plant's loading was projected due to the pretreatment of mercury. It should be pointed out that only a few industrial discharges exhibited mercury levels in excess of BSA's discharge limits and over 89% of the mercury loading was from other sources. Thus, little can be achieved by pretreatment. The high contribution of mercury from the Scajaquada Creek (56%) may be attributed to industrial contributors outside of Buffalo's limits. Once all of the required pretreatment facilities are established, the Bird Island Plant could have a reduction in the present loading ranging from 48.1% for cadmium to 79.0% for copper. This reduction in loading to the treatment plant would reduce the metal content in the sludges. A greater degree of reduction would occur in the sludges metal content since the plant's metal removal efficiency would be less due to the decrease in the influent concentrations. Shown in Table 23, is a comparison of the estimated sludge concentrations with and without industrial pretreatment.

Table 23. PRETREATMENT EFFECTS ON BSA'S SLUDGE

Parameter	Without Pretreatment mg/kg (dry)	With Pretreatment mg/kg (dry)
Copper	1570	330
Lead	1800	605
Nickel	315	115
Zinc	2275	364
Chromium	2540	1040
Cadmium	100	50

As shown in Table 24, the industrial sludges will have high metal concentrations and proper disposal methods will have to be employed.

Sludge disposal options in the Buffalo metropolitan area, are limited for this type of sludge. Research into the methods for reclaiming and recycling metals are presently being conducted. However, when compared to the level of pretreatment required, it is not economically justifiable with the methods available today. Potentially, there are five disposal options which are widely used for the ultimate disposal of sludges. The following is a brief discussion of each relative to its use in this area for the disposal of sludges from chemical precipitation processes.

1. At the present time, landfill disposal of this type of sludge is broadly utilized in the Buffalo area. The relative cost of this disposal method makes it the most economical option presently available to industries. However, increasing restrictions on the allowable metal content may force the creation of specialized landfills to handle metal sludges.

2. The use of a scavenger is another option open to the industries investigated. In addition to accepting sludges, the scavenger may also accept the waste as a liquid and then pretreat it. While the ultimate sludge disposal method used by the scavenger most often falls into one of the other four options, it was included because the potential for reclaiming and recycling the metals is present. For example, one scavenger located in the Buffalo area is seriously looking into recovering metals on a large scale. In fact, he has already recovered copper from a highly concentrated wastewater. However, unless the sludges require additional treatment or specialized storage in the landfill, it is more economical to use the conventional landfill approach.

3. Ocean dumping is not a serious consideration for disposal of the metal sludges since EPA will not approve it and even if they did, the transportation costs from Buffalo would be prohibitive. Sludges are also prohibited from being dumped offshore in Lake Erie.

Table 24. EXAMPLES OF INDUSTRIAL SLUDGE CHARACTERISTICS

SIC Category	Kg/day Removed Dry	Conc @ 5% Solids mg/l	Conc @ 20% Solids mg/l
Cyclic Crude (2865)			
Solids	9.8	5%	20%
Zn	0.64	3405.0	23,314.7
Steel Wire (3315)			
Solids	2383.5	5%	20%
Cd	0.10	2.2	25.1
Cr	6.45	142.0	973.5
Cu	15.03	331.0	2269.2
Pb	0.50	11.0	75.4
Ni	0.41	9.0	61.7
Zn	1.00	22.0	150.8
Fe	53.12	1170.0	8021.0
Plating (3471)			
Solids	1184.9	5%	20%
Cd	1.86	82.5	567.7
Cr	15.89	704.0	4846.0
Cu	10.99	486.8	3350.7
Fe	14.44	639.6	4402.9
Zn	7.17	317.8	2187.6
Ind.Laundry (7218)			
Solids	1162.7	5%	20%
Cd	0.18	8.2	56.2
Cu	3.31	149.6	1026.1
Fe	69.05	3118.0	21,380.3
Pb	11.58	522.7	3584.5
Hg	0.01	0.6	4.2
Zn	3.86	174.2	1194.8

4. The use of metal sludges for land reclamation in high ground water areas or near lakes and streams would only cause a greater problem with water contamination. While land reclamation may be used at selected sites, it is not forseen to be a major method of disposal for this area.

5. Sludges, in general, have been used both as fertilizer and soil conditioner. However, little benefit is seen from using the metal sludges for this purpose. The high metal concentrations, as shown in Table 24, would severely limit its application.

SECTION 9

MUNICIPAL SLUDGE DISPOSAL

INTRODUCTION

It has been shown in the preceding chapters, that the combined treatment of industrial and domestic wastes has many economic advantages. However, combined treatment imposes the need for the careful consideration of the effect the industrial waste has on the entire system. Many of the effects have already been discussed in detail. This section deals with the effect the industrial discharge has on POTW's sludge disposal options. As shown in Table 23, the effects of industrial waste on sludge quality can be significant.

In an area such as Western New York, there are only three major options of ultimate disposal open to the POTW. Those being:

1. Disposal in a landfill;
2. Disposal or recycling for agricultrual purposes; and
3. Co-disposal with solid waste or refuse by incinerator.

It must be kept in mind that in addition to industrial wastes, there are many other factors that will ultimately effect a POTW's decision as to which disposal option best suits their needs, for example:

1. Normally, the sludge process selected by the POTW will not effect their sludge disposal options since ideally, these options are taken into account when the method of processing is selected. In areas where the POTW is still in the planning stage this is essential. However, in today's rapidly changing market, things such as power and fuel, that were economically advantageous to use four years ago, are not today. This is the case in Buffalo, therefore, the BSA must re-evaluate its option, taking into consideration the additional sludge process factor.

2. The geological location of the POTW will affect their option.

3. The location of the other POTWs and large industries with large volumes of sludges and solid waste to be disposed of

will affect their option.

4. The availability of land disposal sites will affect their option.

5. The location of acceptable landfill sites will affect their option.

6. Federal, State and local regulations will affect their options, etc.

Since all of the above are non-industrial related factors, they will not be discussed in this report.

All of the information, conclusions and recommendations presented here have been taken from data obtained for a larger study performed by EPA on sludge disposal problems. That report will be published separately at a later date.

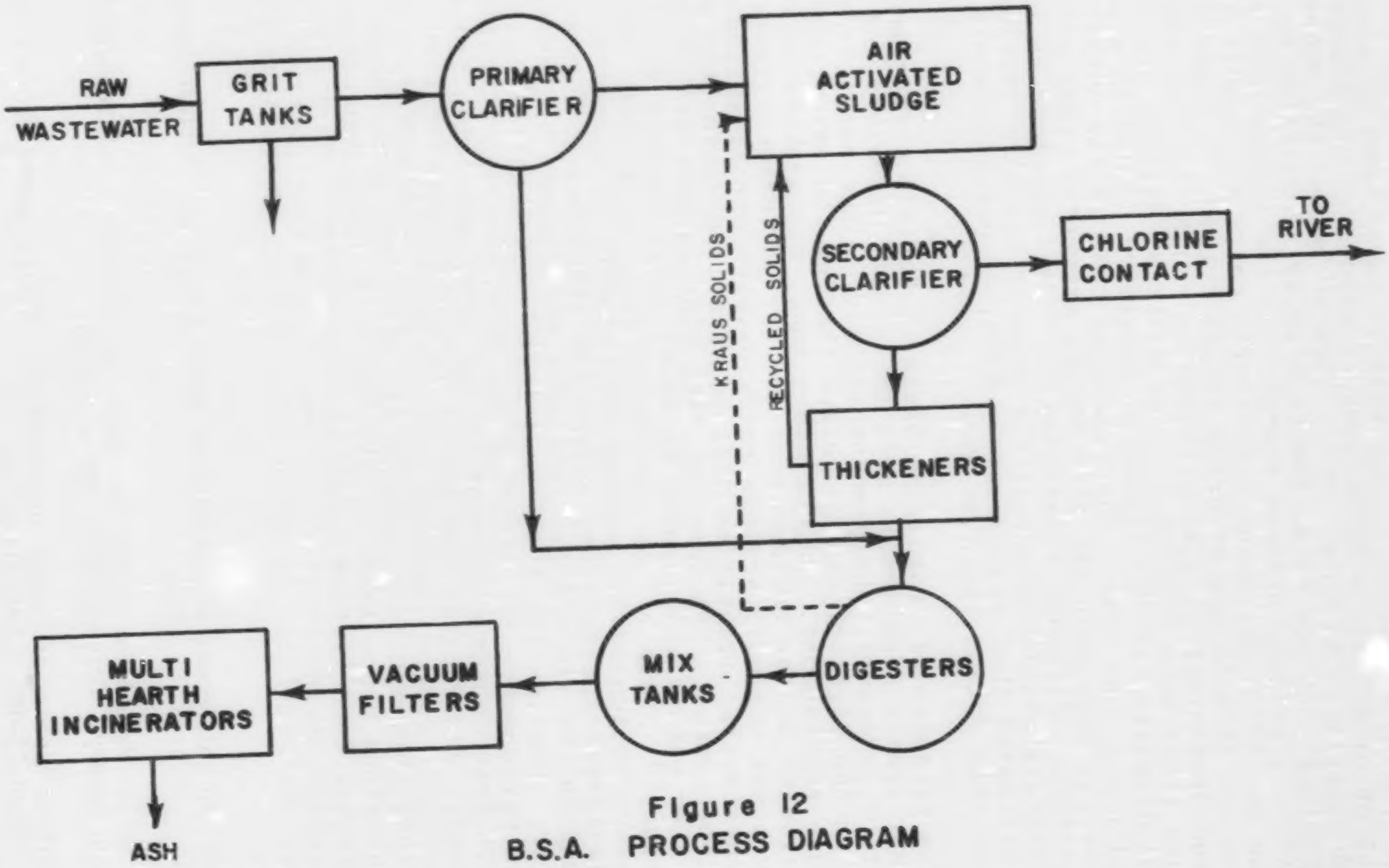
BACKGROUND INFORMATION

The Buffalo Sewer Authority's upgraded Bird Island Treatment plant will be the largest in Erie County. It will produce 17,900 kkg of ash per year which is 43% of the total quantity of sludge disposed of in the county.

In addition to the quantity of sludge produced, the quality of its sludge will also affect Buffalo's options. The high metal concentrations presently in Buffalo's sludge (Section 7, Table 23) may eliminate any agricultural options such as using the sludge for soil conditioner or fertilizer. However, the enforcement of the BSA Sewer Regulations could lower these metal concentrations to levels where the agricultural options could be a viable alternative.

As shown in Figure 13, initially the Authority will use both digestion and incineration in its sludge processing. It is not generally common practice for a POTW to provide both digestion and incineration. However, Buffalo requires digested sludge for operating its activated sludge process in the Kraus mode and incineration to further reduce the sludge volume for disposal. When the BSA plant was in the design stage, it was found that their present location for ash disposal would no longer be available. New disposal sites were scarce. Fuel costs were much lower than they are today and air pollution regulations were less stringent. In light of today's economy, the BSA is re-evaluating its options and investigating alternatives to its present sludge treatment and disposal method.

Since Buffalo utilizes both the digestion and incineration processes in its new plant, they have the options of using either



RAW
WASTEWATER
GRIT TANKS
PRIMARY CLARIFIER
AIR ACTIVATED SLUDGE
KRAUS SOLIDS
RECYCLED SOLIDS
SECONDARY CLARIFIER
CHLORINE CONTACT
TO RIVER
THICKENERS
DIGESTERS
MIX TANKS
VACUUM FILTERS
MULTI HEARTH INCINERATORS
ASH

Figure 12
B.S.A. PROCESS DIAGRAM

one or both in treating their sludge. The decision on which sludge treatment process to use will be based upon an economic evaluation of all the combinations of processes and disposal methods available to them. While this is beyond the scope of this project, the potential can be briefly illustrated by looking at Buffalo's present primary system. In the fiscal year ending on June 30, 1975, the Sewer Authority's costs for sludge incineration was $175.59/kkg of dried solids burned.[18] Since digestion and dewatering is also utilized by the Authority, and if adequate sites were available, a substantial savings could be seen by disposing of the digested, dewatered sludge in a landfill or land reclaiming area. The resulting cost to the Authority would be far less than the $175.59/kkg presently being paid for incineration. Although a detailed study was not made of long term landfill availability, at the present landfill tipping costs, it is estimated that approximately $250,000 per year would be saved if this option could be used.

The presence of industrial waste in Buffalo's treatment plant may create problems in both the use of digestors and incinerators. However, the problems caused by the metal laden sludge in the digestor can be solved through the enforcement of sewer use regulations. On the other hand, the problem of metal laden sludges in the incinerators are air pollution oriented. Mercury poses the most serious metal problem during incineration since substantial quantities will be vaporized during the destruction process. EPA does not feel that an appreciable quantity of other metals will appear in stack gases because of volatilization.[19] A study[20] on the incineration of sludges containing mercury indicated 9.7 percent of the mercury entering a mulitple-hearth incinerator, enters the atmosphere, 59 percent was found in the ash and the remainder was removed by the scrubber water. Considering the actual influent concentration, this level of performance for existing and planned sewage treatment plants in Erie Coundy would meet the national emsission standard for mercury, considering the actual influent concentration. Another area of concern is that toxic organic substances, such as PCB (polychlorinated-biphenyl) may enter the atmosphere. New regulations promulgated by the New York State Department of Environmental Conservation requires after-burners on all multiple hearth sludge incinerators to insure the complete destruction of the PCBs. While little is known about PCB concentrations in sludges, New York State is particularly concerned about their destruction due to the tendencies for PCBs to concentrate in the food chain. For example, just recently, most of the Hudson River was closed to all types of fishing since high levels of PCBs have been detected in stock taken from this source.

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[18] Laehy, G. Annual Report of the Buffalo Sewer Authority. Buffalo Sewer Authority. 1974-1975. p41.

[19] Process Design Manual for Sludge Treatment and Disposal. Environmental Protection Agency. October 1974. p8-43 - 8-54.

[20] Air Pollution Aspects of Sludge Incineration. Environmental Protection Agency. 625/4-75-009. June 1975. p9.

AGRICULTURAL DISPOSAL OPTION

Environmental groups and other sectors of the public in Erie County have been calling for the use of sewage sludge to either reclaim land or for use as fertilizers. At the present time in Erie County, there are no long term plans or needs for land reclamation. The costs of transportation to other areas outside of Erie County for this purpose, such as reclaiming strip mines, make it economically unattractive. As a fertilizer, sewage sludges are relatively poor being deficient in the proper balance of nitorgen, phosphorus and potassium. Dr. J.D. Mendies[21] has rated an average sewage sludge as being 2-1-0.2 (nitrogen, phosphorus, potassium) fertilizer. Coupled with the handling problems the farmers have scheduling it and spreading it in large quantities, there is not much of a market for it. Some other cities in the country have successfully marketed their sludge as a low grade fertilizer. However, their sludge is either high in nitrogen, or they fortify it with chemicals before sale. There are also other cities which have been unsuccessful in selling their sludge as fertilizer, mainly because of the lack of an adequate market.

Sewage sludge is particularly useful as a soil conditioner. Stabilized sewage contains 45-50 percent organic materials which improves the soil tilth and permeability with the added benefit of having a low fertilization value. There are two constraints to the use of Buffalo's present sewage sludge on crop lands: 1) its heavy metals concentration, and 2) the presence of pathogens. Heavy metals, especially zinc, copper, cadmium and nickel are potentially toxic to crops and may be introduced into the food chain. The New York State Department of Environmental Conservation requires proof that hazardous levels of metals will not be present in crops grown for human consumption in sludge conditioned soil. The second constraint is the level of pathogens and their potential for contamination of surface water, ground water, the air, and crops. It is recommended that land conditioned with sludge not be used for human consumable vegetable crops, at least during the first year, unless the sludge has been pasteurized or efficiently composted.

In light of the above discussion, Buffalo's agricultural option would be limited to soil conditioning. Their Sewer Use Regulation would have to be strictly enforced so that the metal concentrations in the sludges were at the levels compatible with its use as a soil conditioner. By enforcement of the sewer regulations, the BSA could reduce the metal concentrations in its waste as shown in Section 8, Table 23.

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[21] Mendies, J.D. Composition and Properties of Sewage Sludge Cropping Up. New York State College of Agriculture. Cornell University. XVIII:5. Sept. 1974. p1-3.

Presently, in Erie County, there is a need for approximately 2800/kkg/yr of dried solids to be used as a soil conditioner. Even with three out of the four new secondary treatment plants in the area utilizing incineration as their sludge reduction process, the present demand for soil conditioning does not exceed the supply if Buffalo exercises this option. Thus, the BSA would have to expand the present market, which largely consists of home owners, to include more usage on farm, parks, and recreational area.

LANDFILL OPTION

The sanitary landfill is presently being used for the disposal of both sludge and ash. Under present landfilling methods, these sludges are incorporated either into the face of the fill matter or combined with the cover material. Since the pH of the material in a sanitary landfill is normally acidic, this creates the problem of the resolublization of metals which during wet weather would leach out into the groundwater or drainage system. Therefore, it is recommended, since new regulations are presently being established, that these regulations be carefully considered in the design stages. For example, as a result of requests made by county health authorities, one of the larger landfills in the area recently sent to its customers a notice indicating substances which will not be accepted for disposal; included were the metals found in Buffalo's sludges. Since the request was not specific by including limiting concentrations, this implies that Buffalo's municipal sludge would be prohibited. Since all waste even domestic, will contain some metals, the lack of specific limits in the regulations prevents us from determining what, if any, effect the industrial control of metals has on this option. The costs for the use of landfills ranged from $6.00 to $11.00/kkg, plus the cost of transportation. However, many landfills have not yet established fixed charges for sludges. In most cases they would rather not handle it because of the equipment problems it produces.

In evaluating the landfill option, the POTW must consider both the transportation costs and the costs charged by the landfill. For long term projects, incineration of the sludge before disposal in the landfill may prove to be cost-effective since it would drastically reduce both costs by reducing the volume. For example, assuming a POTW has to process and dispose of 1,500,000 kkg/year of wet sludge containing 50% volatiles of 2% solids, one of two methods could be used: 1) digestion followed by dewatering to 20% by weight, and 2) dewatering, followed by incineration. If the digestion process were to be used, approximately 102,000 kkg/yr of wet sludge would be generated. If incineration were to be used, only 15,000 kkg/yr of ash would have to be disposed of. If the reduction in transportation and landfill costs resulting from the use of incineration exceeds the difference in O&M and amortization costs between incineration and digestion, then incineration would be the cost effective method.

CO-DISPOSAL OF REFUSE AND SEWAGE SLUDGE

Co-disposal of refuse and sewage sludge is being evaluated by Erie County's Southtowns Sewage Agency for use at its new sewage treatment plant.[22] The concept is to locate pyrolysis oxygen furnaces, oxygen generation facilities and wastewater facilities at a common location. Each process would augment the other, the pyrolysis units disposing of the sewage sludge, the wastewater treatment plant supplying cooling and flushing water as well as treating the contaminated wastewater, and the oxygen facilities supplying oxygen to both facilities. The new savings in the cost of constructing the wastewater treatment facility would be approximately 3.6 million dollars.

The solid waste facilities would include shredding, ferrous metal separation and pyrolysis units. The manufacturer, Union Carbide, estimated that the quantity of sludge that could be handled jointly with the refuse is 20-30 percent of the total capacity of the incinerator. The sludge dewatered to 25 percent would result in negligible losses of energy. Sludge with higher solids content could produce enough energy to make it a marketable commodity. New York State has expressed an interest in a facility of this nature and grant funds are available to pay up to 50 percent of the construction costs. In addition, EPA and NYDEC will provide 75% and 12.5 % of the funds necessary for that portion of the facility for wastewater treatment. The annual conceptual cost estimates for the solid waste facility are shown in Table 25.

Generally, the use of landfills which are relatively close to the refuse source was found to be more economical than co-disposal. However, as the distance to the landfill increases, the increase in transportation costs make the pyrolysis method more attractive. The Lancaster Sanitary Landfill would be available for refuse for some time. Tipping costs are presently $5.70

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[22] McPhee, Smith, Rosenstein Engineers. Technical Memorandum on Solid Waste Disposal Facilities Being Combined With Wastewater Treatment Facilities at the Southtowns Site. Erie County's Southtowns Sewage Agency. February 1976. p7.

Table[22] 25. ANNUAL COSTS FOR SOLID WASTE DISPOSAL FACILITY

Net Annual Costs

	1980	2000
Operating and Maintenance	$3,712,000	$5,294,000
Debt Service	1,600,000	1,600,000
Wastewater Debt Credit	(43,000)	(43,000)
Total	$5,269,000	$6,851,000
Annual Tonnage	197,830	385,000
Cost per Ton	$ 26.63	$ 18.76

Credit for Sale of Metals

	1980	2000
Gross Cost per Ton	$26.63	$18.77
Credit for Metal	(2.50)	(2.50)
Net Cost per Ton	$24.13	$16.26

Credit for Sale of Metals and Gas @ $\$0.75/10^6$ BTU

	1980	2000
Gross Cost per Ton	$26.63	$18.77
Credit for Metal	(2.50)	(2.50)
Credit for Gas	(5.63)	(5.63)
Net Cost per Ton	$18.50	$10.63

Credit for Sale of Metals and Gas @ $\$1.50/10^6$ BTU

	1980	2000
Gross Cost per Ton	$26.63	$18.76
Credit for Metal	(2.50)	(2.50)
Credit for Gas	(11.25)	(11.25)
Net Cost per Ton	$16.25	$ 5.01

per ton of refuse with sludge tipping charges being four times that amount, depending on the handling problems encountered. To be cost effective, compared to the use of the Lancaster Landfill, the solid waste co-disposal facility would have to operate at near capacity and sell all its off-gases at $1.50/$10^6$ BTU. The industrial contribution to Buffalo's waste treatment system would not be a hindrance to the utilization of this option. In fact, if co-disposal were to become a reality, the POTW would neither have to digest or incinerate, merely dewater.

SECTION 10

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SECTION 12

APPENDICES

A Characteristics of SIC Categories

B Sewer Use Regulations

C Pilot Plant Investigation's Background Data

APPENDIX A

CHARACTERISTICS OF SIC CATEGORIES

Table A-1 CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Meat Packing (2011)			Prepared Meats (2013)			Creamery Butter (2021)			Cheese (2022)		
	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.
	Kg/day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l
B.O.D.	339	1.4	802	2495.9	10.4	721	44.53	0.2	324	736.5	3.1	5803
C.O.D.	706	1.2	1671	4198.3	7.3	1213	80.81	0.1	588	1552.2	2.7	12,338
Chlorine Demand	16.2	0.6	38.4	54.18	2.0	15.6	0.52	<0.1	3.8	2.6	0.1	20
Total Solids	595	0.3	1410	8,841	4.6	2553	60.39	<0.1	439	1039.8	0.5	8193
Total S.S.	128.6	0.7	305	830.1	4.7	240	15.95	0.1	116	34.24	0.2	270
Grease & Oil	23.8	0.4	56.4	88.9	1.6	25.7	18.82	0.3	137	13.54	0.2	107
Phosphate	0.78	0.1	1.83	541.1	38.5	156	0.15	<0.1	1.1	6.24	0.4	49
Arsenic												
Cyanide												
Cadmium												
Chromium-hex												
Chromium-total												
Copper												
Lead												
Mercury												
Nickel												
Zinc												
Discharge-MGD	0.1115	0.6	0.1115	0.9145	4.7	0.9145	0.0363	0.2	0.0363	0.0335	0.2	0.0335
No. of Industries	7	3.1	7	13	5.8	13	1	0.4	1	2	0.89	2
Weight % S.I.C. Sampled	60.6			89.8			100			88.0		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Ice Cream (2024)			Fluid Milk (2026)			Pickles (2035)			Flour (2041)		
	S.I.C. Kg /day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg /day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	104.7	0.4	122	6,990	29.2	3579	1843.[illegible]	7.7	4725	3.21	<0.1	13.67
C.O.D.	235.5	0.4	277	9,251	16.2	4747	2297.0	4.0	5887	9.6	<0.1	41.1
Chlorine Demand	8.25	0.3	9.7	34.35	1.2	18	24.43	0.9	63	0.365	<0.1	1.6
Total Solids	417.3	0.2	490	8,054	4.2	4133	6,390	3.3	16,377	55.1	<0.1	235
Total S.S.	68.5	0.4	80	1,261	7.1	647	38.1	0.2	98	5.06	<0.1	22
Grease & Oil	394.0	7.0	463	123	2.2	63	5.93	0.1	15			
Phosphate	21.0	1.5	25	290	20.7	149	4.76	0.3	12	0.25	<0.1	1.1
Arsenic												
Cyanide												
Cadmium												
Chromium-hex												
Chromium-total												
Copper												
Lead												
Mercury												
Nickel												
Zinc												
Discharge-MGD	0.225	1.1	0.225	0.5147	2.6	0.5147	0.1030	0.5	0.1030	0.0619	0.30	0.0619
No. of Ind.	1	0.44	1	3	1.33	3	1	0.44	1	2	0.89	2
Weight % S.I.C. Sampled	100			91.8			100			66.4		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Pet Food (2047)			Bread (2051)			Animal Fat & Oil (2077)			Shortening (2079)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	40.5	0.2	195	750	3.1	984	110.1	0.5	645	1399.1	5.8	1068
C.O.D.	101.6	0.2	489	1040	1.8	1364	630	1.1	3674	1927	3.4	1471
Chlorine Demand	0.75	<0.1	3.6	8.2	0.3	11	6.5	0.2	37.8	4.7	0.2	3.6
Total Solids	138.6	0.1	666	993	0.5	1303	594	0.3	3470	1378.4	0.7	1052
Total S.S.	20.3	0.1	98	415	2.3	546	444	2.5	2587	331.5	1.9	253
Grease & Oil	2.31	<0.1	11	81.9	1.4	108	5.2	0.1	32.7	103.8	1.8	79
Phosphate	2.26	0.2	11	11.51	0.8	15	0.56	0.1	3.5	8.05	0.6	6.1
Arsenic												
Cyanide												
Cadmium												
Chromium-hex												
Chromium-total												
Copper												
Lead												
Mercury												
Nickel												
Zinc												
Discharge-MGD	0.0549	0.3	0.0549	0.2013	1.0	0.2013	0.0455	0.2	0.0455	0.4070	2.1	0.4070
No. of Industries	2	0.89	2	15	6.67	15	1	0.44	1	1	0.44	1
Weight % S.I.C. Sampled	45.7	—	—	50.7			100			100		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Malt (2083)			Soft Drinks (2086)			Macaroni & Spaghetti (2098)			Narrow Fabric Mills (2241)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	107.45	0.4	403	9.42	<0.1	44	71.2	0.3	417	16.06	0.1	9.47
C.O.D.	196.9	0.3	739	21.9	<0.1	103	115.7	0.2	677	144.3	0.3	85.1
Chlorine Demand	6.30	0.2	23	0.51	<0.1	2.4	0.92	<0.1	5.4	1.61	0.1	0.95
Total Solids	170.4	0.1	639	125.1	0.1	589	178.9	0.1	1048	146.3	0.1	86.3
Total S.S.	39.01	0.2	146	10.19	0.1	48	12.5	0.1	73	44.73	0.3	26.4
Grease & Oil	0.64	<0.1	2.4	1.27	<0.1	6.0	1.8	<0.1	10.9	12.19	0.2	7.19
Phosphate	7.03	0.5	26	0.229	<0.1	1.1	5.3	0.4	31	1.02	0.1	0.60
Arsenic												
Cyanide												
Cadmium												
Chromium-hex												
Chromium-total												
Copper												
Lead												
Mercury												
Nickel												
Zinc												
Discharge-MGD	0.0704	0.4	0.0704	0.0561	0.3	0.0561	0.0451	0.2	0.0451	0.4478	2.3	0.4478
No. of Industries	1	0.44	1	8	3.6	8	1	0.4	1	2	0.89	2
Weight % S.I.C. Sampled	100			75.3			94.7			70.5		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Converted Paper Products (2649)			Corrugated Boxes (2653)			Newspapers (2711)			Commercial Printing (2751)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	41.16	0.2	191	93.4	0.4	237	25.1	0.1	57.3	0.39	<0.1	2.7
C.O.D.	726.7	1.3	3369	522.2	0.9	1327	103.7	0.2	236	15.2	<0.1	107
Chlorine Demand				3.49	0.1	8.9	1.21	<0.1	2.8	0.26	<0.1	1.8
Total Solids	1364.2	0.7	6318	439.6	0.2	1117	141.1	0.1	321	112.7	0.1	788
Total S.S.	1184.5	6.7	5485	334.9	1.9	851	39.5	0.2	90	17.51	0.1	122
Grease & Oil	6.1	0.1	28	91.0	1.6	231				1.66	<0.1	12
Phosphate	0.67	<0.1	3.1	1.04	0.1	2.6	2.53	0.2	5.8	0.74	0.1	5.2
Arsenic												
Cyanide												
Cadmium				0.0094	0.2	0.024						
Chromium-hex												
Chromium-total										0.0272	<0.1	0.19
Copper	0.138	0.1	0.64									
Lead												
Mercury	<0.00028			0.00023	0.2	0.0006				0.00005	<0.1	0.0004
Nickel												
Zinc							0.2	0.6	0.62		0.1	0.28
Discharge-MGD	0.0570	0.3	0.0570	0.1039	0.5	0.1039	0.1160	0.6	0.1160	0.0378	0.2	0.0378
No. of Industries	1	0.44	1	3	1.33	3	5	2.22	5	6	2.67	6
Weight % S.I.C. Sampled	100			65.7			66.7			38.4		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Manifold Business Forms (2761)			Pharmaceutical (2834)			Paints (2851)			Cyclic Crudes (2865)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	38.15	0.2	59	1118.6	4.7	3116	2.93	<0.1	17	2883.7	12.1	384
C.O.D.	108.1	0.2	167	3306.7	5.8	9212	13.61	<0.1	78	11,071	19.3	1474
Chlorine Demand	15.07	0.5	23.0	4.65	0.2	13	0.48	<0.1	2.8	682	24.8	91
Total Solids	280.0	0.1	432	1564	0.8	4357	27.8	<0.1	159	81,454	42.2	10,839
Total S.S.	29.0	0.2	45	196.3	1.1	547	6.9	<0.1	40	1490.7	8.4	199
Grease & Oil	23.24	0.4	36	91.7	1.6	255	5.65	<0.1	32	61.7	1.1	8.2
Phosphate	10.60	0.8	16	1.851	0.1	5.2	0.271	<0.1	1.6	19.95	1.4	2.6
Arsenic				0.0172								
Cyanide	0.032	0.1	0.05							2.8	10.8	0.36
Cadmium												
Chromium-hex												
Chromium-total							0.0052					
Copper				0.0292	<0.1	0.08				17.5	10.1	2.3
Lead	0.0374	0.2	0.06									
Mercury	0.0031	2.1	0.005	<0.00215								
Nickel										2.50	3.9	0.34
Zinc				0.146	0.1	0.41	0.0397	<0.1	0.23	5.1	1.8	0.68
Discharge-MGD	0.1715	0.9	0.1715	0.0948	0.5	0.0948	0.0461	0.2	0.0461	1.9835	10.1	1.9835
No. of Industries	1	0.44	1	3	1.33	3	4	1.78	4	1	0.44	1
Weight % S.I.C. Sampled	100			77.2			76.4			100		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Fabricated Rubber Products (3069)			Purchased Glass Products (3231)			Pottery (3269)			Steel Mills (3312)		
	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.
	Kg./day	Ind. Total	mg/l	Kg /day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l	Kg /day	Ind. Total	mg/l
B.O.D.	3.31	<0.1	9.5	4.64	<0.1	9.4	3.50	<0.1	9.1	14.51	0.1	8.6
C.O.D.	19.3	<0.1	55	34.49	0.1	70	12.49	<0.1	32	62.6	0.1	37
Chlorine Demand	0.67	<0.1	1.9	0.9	<0.1	1.9	2.03	0.1	5.3	3.67	0.1	2.2
Total Solids	122.4	0.1	350	223.1	0.1	450	205.7	0.1	535	404.4	0.2	242
Total S.S.	6.37	<0.1	18	71.4	0.4	144	97.3	0.5	253	80.3	0.5	48
Grease & Oil	22.12	0.4	63	3.87	0.1	7.8	2.9	0.1	7.6	52.6	0.9	31
Phosphate	0.33	<0.1	0.94	6.54	0.5	13	0.59	<0.1	1.6	2.42	0.2	1.4
Arsenic												
Cyanide												
Cadmium				<0.0101		<0.020						
Chromium-hex				<0.0362		<0.073						
Chromium-total				0.0261	<0.1	0.05						
Copper				<0.0291		<0.059						
Lead				<0.052		<0.105	4.10	16.6	11	0.147	0.6	0.09
Mercury				0.000226	0.2	0.0005						
Nickel				0.368	0.6	0.74				<0.09		
Zinc							46,126			0.113	<0.1	0.07
Discharge-MGD	0.0923	0.5	0.0923	0.1310	0.7	0.1310	0.1016	0.5	0.1016			0.4418
No. of Industries	3	1.33	3	2	0.89	2	1	0.44	1	2	0.89	2
Weight % S.I.C. Sampled	9.8			71.0			100			100		

Table A-I Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Steel Wire (3315)			Cold Finishing of Steel (3316)			Gray Iron Foundaries (3321)			Malleable Iron Foundaries (3322)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	475.9	2.0	707	12.19	0.1	14	14.29	0.1	31	14.03	0.1	66
C.O.D.	928.9	1.6	1381	44.09	0.1	52	107.5	0.2	234	37.76	0.1	179
Chlorine Demand	1605.3	58.2	2387	1.14	<0.1	1.3	3.79	0.1	8.3	1.26	<0.1	6.0
Total Solids	36,467	18.9	54,243	228.3	0.1	271	213.3	0.1	465	319.9	0.2	1514
Total S.S.	201.1	1.1	299	14.05	0.1	17	125.9	0.7	275	63.6	0.4	301
Grease & Oil	8.05	0.1	12	3.9	0.1	4.7	4.9	0.1	11	0.78	<0.1	3.7
Phosphate	20.41	1.5	30	2.35	0.2	2.8	1.37	0.1	3.0	3.7	0.3	17.6
Arsenic												
Cyanide	2.4	9.4	3.6									
Cadmium	0.16	4.1	0.24									
Chromium-hex	199.2	76.9	296							0.015	<0.1	0.07
Chromium-total	277.5	70	412							0.083	<0.1	0.40
Copper	58.1	33	86									
Lead	4.3	17.2	6.4				0.0451	0.2	0.10			
Mercury												
Nickel	3.7	5.9	5.5	0.0163	<0.1	0.02	0.0233	<0.1	0.05	0.108	0.2	0.52
Zinc	7.6	2.7	11				0.054	<0.1	0.12	33.43	11.9	158
Discharge-MGD	0.1776	0.9	0.1776	0.2230	1.1	0.2230	0.1211	0.6	0.1211	0.0558		0.0558
No. of Industries	1	0.44	1	1	0.44	1	3	1.33	3	1	0.44	1
Weight % S.I.C. Sampled	100			100			81.8			100		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Steel Foundaries (3325)			Copper Rolling (3351)			Hand & Edge Tools (3423)			Fabricated Plate Work (3443)		
	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.
	Kg/day	Ind. Total	mg/l	Kg /day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l	Kg /day	Ind. Total	mg/l
B.O.D.	67.62	0.3	24	176.5	0.7	21	49	0.2	24	94.6	0.4	53
C.O.D.	1190.0	2.1	582	1370.3	2.4	159	269.7	0.5	131	365.6	0.6	204
Chlorine Demand	17.14	0.6	8.5	20.64	0.7	2.4				7.31	0.3	4.1
Total Solids	5,140	2.7	2571	4,512	2.3	524	1266.8	0.7	614	2849.5	1.5	1589
Total S.S.	4,653	26.2	2360	457.1	2.6	53	178.1	1.0	86	640.8	3.6	357
Grease & Oil	45.9	0.8	23	91.83	1.6	11	84.1	1.5	41	34.41	0.6	19
Phosphate	17.96	1.3	8.9	8.25	0.6	0.96	19.55	1.4	9.5	13.54	1.0	7.6
Arsenic												
Cyanide												
Cadmium				0.206	5.2	0.02	0.0089	0.2	0.004			
Chromium-hex							5.19	2.0	2.5			
Chromium-total							5.44	1.4	2.6			
Copper				12.38	7.1	1.4						
Lead	0.45	1.8	0.23									
Mercury												
Nickel	1.770	2.8	0.90	0.309	0.5	0.04	3.95	6.2	1.9			
Zinc	0.54	0.2	0.25	79	28.3	9.23	1.24	0.4	0.6	1.29	0.5	0.72
Discharge-MGD	0.5518	2.8	0.5518	2.2728	0.89	2.2728	0.5450	2.8	0.5450	0.4737	2.4	0.4737
No. of Industries	4	1.78	4	2	0.89	2	3	1.33	3	7	3.11	7
Weight % S.I.C. Sampled	66.7			100			97.0			92.2		

Table A-1 continued. CHARACTERISTICS OF SIC CATEGORIES

Parameters	Metal Stampings (3469)			Plating & Polishing (3471)			Steel Springs (3493)			Machine Tools (3541)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	85.4	0.4	113	15.7	0.1	6.6	4.39	<0.1	8.4	1.53	<0.1	13.3
C.O.D.	476.8	0.8	633	125.4	0.2	52.5	25.02	<0.1	48	5.38	<0.1	47
Chlorine Demand	4.42	0.2	5.9	3.09	0.1	1.3	2.17	0.1	4.2	0.11	<0.1	1.0
Total Solids	670.0	0.3	890	1277	2.2	535	123.8	0.1	235	32.57	<0.1	283
Total S.S.	65.2	0.4	87	132.0	0.7	55	4.07	<0.1	7.8	2.8	<0.1	24
Grease & Oil	26.99	0.5	36	11.48	0.2	4.8	2.76	<0.1	5.3	7.73	0.1	67
Phosphate	13.91	1.0	18	11.74	0.8	4.9	2.48	0.2	4.7	0.303	<0.1	2.6
Arsenic	0.0058	75.9	0.0078									
Cyanide	0.0280	0.1	0.037	5.41	20.7	2.3	0.63	2.4	1.2			
Cadmium				2.32	57.9	0.97	0.40	10.1	0.8	0.0038	0.1	0.03
Chromium-hex	0.126	<0.1	0.17	18.04	7.0	7.6	<0.016					
Chromium-total	0.216	<0.1	0.29	18.22	4.5	7.6	0.011	<0.1	0.02			
Copper	0.108	0.1	0.14	11.99	6.9	5.0	0.033	<0.1	0.063			
Lead	0.0034	<0.1	0.0046	0.039	0.2	0.017	0.026	0.1	0.05	0.047	0.2	0.41
Mercury				0.00366	2.5	0.0015	0.0003	0.2	0.0006			
Nickel	0.117	0.2	0.16	24.92	39.2	10.4						
Zinc	0.126	<0.1	0.17	8.51	3.0	3.6						
Discharge-MGD	0.1989	1.0	0.1989	0.6309	3.2	0.6309	0.1389	0.7	0.1389	0.0304	0.2	0.0304
No. of Industries	7	3.11	7	13	5.78	13	1	0.44	1	4	1.78	4
Weight % S.I.C. Sampled	91.9			70.2			100			95.8		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Blowers & Fans (3564)			Refrig. & Heat. Equip. (3585)			Motor Vehicle Parts (3714)			Manufacturing Industries (3999)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	4.84	<0.1	12.5	25.1	0.1	17	309.7	1.3	31.5	249.5	1.04	387
C.O.D.	26.5	<0.1	68	134.6	0.2	91	1700.6	3.0	173	521.6	0.9	809
Chlorine Demand	0.88	<0.1	2.3	4.95	0.2	3.36	71.8	2.6	7.3	5.06	0.2	7.9
Total Solids	116.8	0.1	301	1117.8	0.6	758	6,783	3.5	691	1353.8	0.7	2101
Total S.S.	31.6	0.2	82	88.8	0.5	60	1,401	7.9	143	309.1	1.7	480
Grease & Oil	0.79	<0.1	2.0	6.54	0.2	4.4	2896	51.2	295	27.58	0.5	43
Phosphate	1.53	0.1	4.0	28.12	2.0	19	89.5	6.4	9.1	7.96	0.6	12
Arsenic	0.0018	24.1	0.0048									
Cyanide							14.13	54.0	1.4			
Cadmium							0.1187	3.0	0.01			
Chromium-hex							36.51	14.1	3.7			
Chromium-total							95.5	24	9.7			
Copper							69.5	39.9	7.1			
Lead	0.046	0.2	0.12				0.847	3.4	0.086			
Mercury												
Nickel							25.78	40.5	2.6			
Zinc				113.2	40.3	76.7	10.13		1.03			
Discharge-MGD	0.1026	0.5	0.1026	0.3896	2.0	0.3896	2.5941	13.2	2.5941	0.1702	0.9	0.1702
No. of Industries	1	0.44	1	3	1.33	3	6	2.67	6	3	1.33	3
Weight % S.I.C. Sampled	100			95.9			75.4			97.7		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Gas Production (4925)			Poultry Products (5144)			Industrial Supplies (5085)			Eating Places (5812)		
	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.	S.I.C.	% of	Conc.
	/day	Ind. Total	mg/l	/day	Ind. Total	mg/l	/day	Ind. Total	mg/l	Kg/day	Ind. Total	mg/l
B.O.D.	101.08	0.5	122	18.12	0.1	186	245.9	1.0	1760	185.4	0.8	566
C.O.D.	683.3	1.2	763	46.37	0.1	475	1156	2.0	8277	396.2	0.7	1210
Chlorine Demand	22.44	0.8	25	0.87	<0.1	8.9	3.06	0.1	22	1.65	0.1	5
Total Solids	1623.3	0.8	1814	50.57	<0.1	518	925	0.5	6623	352.7	0.2	1077
Total S.S.	199.42	1.1	223	16.97	0.1	173	228	1.3	1635	158.3	0.9	483
Grease & Oil	11.2	0.2	12.5	1.16	<0.1	12	260.5	4.6	1864	81.7	1.4	249
Phosphate	5.0	0.4	5.6	1.43	0.1	15	7.18	0.5	51.4	2.24	0.2	6.8
Arsenic	<0.0050											
Cyanide	0.64	2.5	0.72									
Cadmium							0.040	1.0	0.29			
Chromium-hex												
Chromium-total							0.040	<0.1	0.29			
Copper							0.087	0.1	0.62			
Lead							3.01	12.2	21.6			
Mercury							0.024	16.0	0.17			
Nickel							0.0082	<0.1	0.059			
Zinc							2.51	0.9	18			
Discharge-MGD	0.2364	1.2	0.2364	0.0258	0.1	0.0258	0.0369	0.2	0.0369	0.0865	0.4	0.0865
No. of Industries	3	1.33	3	1	0.44	1	5	2.22	5	16	7.11	16
Weight % S.I.C. Sampled	100			100			25.5			38.6		

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Power Laundries (7211)			Linen Supply (7213)			Dry Cleaning Plants (7216)			Industrial Launderers (7218)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	79.6	0.3	249	194.6	0.8	514	5.09	<0.1	19	1419	5.9	482
C.O.D.	173.4	0.3	543	354.2	0.6	936	19.2	<0.1	69	6,411	11.2	2176
Chlorine Demand	1.18	<0.1	3.7	2.3	0.1	6.0	0.46	<0.1	1.7	13.33	0.5	4.6
Total Solids	255.6	0.1	801	615.4	0.3	1627	104.1	0.1	373	5,849	3.0	1986
Total S.S.	38.6	0.2	121	58.1	0.3	153	11.6	0.1	42	1,253.8	7.1	426
Grease & Oil	3.48	0.1	10.9	36.28	0.6	96	3.65	0.1	13	568.3	10.0	193
Phosphate	5.51	0.4	17	12.7	0.9	34	1.58	0.1	5.8	117.3	8.4	40
Arsenic												
Cyanide												
Cadmium										0.58*	14.6	0.29*
Chromium-hex												
Chromium-total										0.90*	0.2	0.44*
Copper										4.13*	2.4	2.04*
Lead										11.7*	47.2	5.8*
Mercury										0.0316*	21.4	0.016*
Nickel												
Zinc										5.1*	1.8	2.5*
Discharge-MGD	0.0843	0.4	0.0843	0.0999	0.5	0.0999	0.0724	0.4	0.0724	0.7779	4.0	0.7779
No. of Industries	4	1.78	4	3	1.33	3	15	6.67	15	6	2.67	6
Weight % S.I.C. Sampled	76.9			84.5			49.4			94.9		

* Note: Heavy metal loadings include only three industries having a total flow of 535,494 gpd.

Table A-1 Continued CHARACTERISTICS OF S.I.C. CATAGORIES

Parameters	Photofinishing Laboratories (7395)			Car Washes (7542)			General Medical Hospitals (8062)		
	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l	S.I.C. Kg/day	% of Ind. Total	Conc. mg/l
B.O.D.	35.90	0.2	210	3.56	<0.1	38	737.0	3.1	71
C.O.D.	77.2	0.1	452	21.4	<0.1	228	2088.8	3.6	201
Chlorine Demand	7.1	0.3	36	0.74	<0.1	7.9	68.6	2.5	6.6
Total Solids	105.5	0.1	617	47.3	<0.1	504	4,938	2.6	475
Total S.S.	4.0	<0.1	24	13.17	0.1	140	587.3	3.3	56
Grease & Oil				1.26	<0.1	13.4	197.0	3.5	19
Phosphate	0.034	<0.1	0.2	0.092	<0.1	0.98	59.8	4.3	5.8
Arsenic									
Cyanide	0.00085	<0.1	0.005						
Cadmium							0.147	3.7	0.014
Chromium-hex									
Chromium-total									
Copper	0.0083	<0.1	0.048						
Lead									
Mercury							0.084	57.4	0.0082
Nickel									
Zinc	0.011	<0.1	0.066						
Discharge-MGD	0.0452	0.2	0.0452	0.0248	0.1	0.0248	2.7468	14.0	2.7468
No. of Industries	1	0.44	1	3	1.33	3	15	6.67	15
Weight % S.I.C. Sampled	100			42.6			37.8		

APPENDIX B

SEWER USE REGULATIONS

Figure B-1

SEWER REGULATIONS
OF THE
BUFFALO SEWER AUTHORITY

Buffalo Sewer Authority
Room 1038 City Hall
Buffalo, N.Y. 14202

INTRODUCTION

WHEREAS the Buffalo Sewer Authority was created by Chapter 349 of the Laws of 1935 (now Title 8 of Article 5 of Chapter 870 of the Laws of New York of 1939, Sections 1175 to 1195 of the Public Authorities Law,) and

WHEREAS upon the completion of the "Project" as defined in Section 1176, sub-division 8 of the Public Authorities Law, the Buffalo Sewerage System theretofore constructed by the City of Buffalo was assigned, transferred and dedicated to the use and was thereafter in the possession of and under the jurisdiction, control and supervision of the Buffalo Sewer Authority, and

WHEREAS, the Buffalo Sewer Authority has, since the completion of the "Project" constructed additions and betterments to the public sewerage system including stormwater and sanitary sewers, and

WHEREAS the Federal Government has enacted Public Laws 84-660 and Public Laws 92-500, and the Buffalo Sewer Authority desires to remain in compliance therewith, and

WHEREAS, the Buffalo Sewer Authority desires to assure that the use of the public sewerage system operated by it will conform to the best sanitary engineering practices, and desires to regulate the use of the facilities of the Buffalo Sewer Authority, and

WHEREAS, the Plumbing Code, the Building Code and the Health Ordinances of the City of Buffalo regulate to a substantial degree, the construction and use of building service sewers and the disposal of the sewage and wastes:

NOW, THEREFORE, the following Regulations, which shall be considered supplementary to the Plumbing Code, the Building Code and the Health and other applicable ordinances of the City of Buffalo, are hereby adopted by the Buffalo Sewer Authority:

ARTICLE I

DEFINITIONS

Unless the context specifically indicates otherwise, the meaning of terms used in these Regulations shall be as follows:

Sec. 1 "ABNORMAL STRENGTH SEWAGE" shall mean any waste having a suspended solid, BOD, chlorine demand or total phosphate concentration in excess of that found in normal strength sewage, but which is otherwise acceptable into a public sewer under the terms of these Regulations.

Sec. 2 "A.S.T.M." shall mean the American Society for Testing and Materials.

Sec. 3 "BOD" (denoting Biochemical Oxygen Demand) shall mean the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days at 20°C, expressed in milligrams per liter.

Sec. 4 "BSA, THE AUTHORITY, SEWER AUTHORITY" shall mean the Buffalo Sewer Authority.

Sec. 5 "BUILDING DRAIN" is that part of the horizontal piping of a building drainage system which receives the discharge of all soil, waste and other drainage from inside the walls of any building and conveys the same to the building service sewer five feet outside the foundation wall of such building.

Sec. 6 "BUILDING SERVICE SEWER" is that part of the horizontal piping of a building drainage system beginning five feet from the foundation wall and terminating at its connection with the main sewer, cesspool, bacterial tank or other disposal terminal.

Sec. 7 "CHLORINE DEMAND" shall mean the difference between the amount of chlorine added to water, sewage or industrial wastes and the amount of residual chlorine remaining at the end of a fifteen (15) minute contact period.

Sec. 8 "COLLECTING SEWER" shall mean a sewer that receives wastewater and discharges into a main sewer serving more than one (1) collecting sewer.

Sec. 9 "COMBINED SEWER" is a public sewer or drain intended to receive domestic sewage, industrial water carried wastes, as well as surface, and storm waters.

Sec. 10 "COMMON SEWER" shall mean a building service sewer or building drain that receives wastewater from more than one (1) discharger before it empties into a collecting sewer.

Sec. 11 "COMPATIBLE POLLUTANT" shall mean Biochemical Oxygen Demand (BOD), total suspended solids (TSS), pH, fecal coliform bacteria, chlorine demand, phosphorus and phosphorus compounds, fats, oils and greases of animal or vegetable origin, except as prohibited herein or identified on Buffalo Sewer Authority's National Pollution Discharge Elimination System Permit.

Sec. 12 "COMPOSITE SAMPLE" shall mean a sample consisting of several effluent portions collected during a specific time period and combined to make a representative sample.

Sec. 13 "COMPOSITE SEWAGE" shall mean sewage consisting of several effluent portions collecting from various discharge lines at a common point.

Sec. 14 "COOLING WATER" shall mean the water discharged from any system of condensation such as air conditioning, cooling or refrigeration.

Sec. 15 "DIRECT DISCHARGE" shall mean the conveyance of waste from a building service sewer, uninterupted to a BSA public sewer.

Sec. 16 "DOMESTIC SEWAGE" shall mean a combination of the water carried normal strength sewage from residences, business buildings, institutions and industrial establishments.

Sec. 17 "DOMESTIC USER" shall mean any user not covered under the definition of "Industrial User" or "Commercial User".

Sec. 18 "EPA" shall mean the United States Environmental Protection Agency.

Sec. 19 "GARBAGE" shall mean solid wastes from the domestic and commercial preparation, cooking and dispensing of food, and from the handling, storage and sale of produce.

Sec. 20 "GENERAL MANAGER" shall mean the Chief Executive Officer of the Buffalo Sewer Authority or his authorized deputy, agent or representative.

Sec. 21 "GROUNDWATER" shall mean water within the earth that supplies wells and springs.

Sec. 22 "INCOMPATIBLE POLLUTANT" shall mean any pollutant which is not a compatible pollutant.

Sec. 23 "INDIRECT DISCHARGE" shall mean the conveyance of waste to a public BSA sewer by any means other than that defined in Section 13 of this Article.

Sec. 24 "INDUSTRIAL USER" shall mean any industrial or commercial establishment with a classification as designated in the "Standard Industrial Classification Manual" 1972 edition, as published by the Executive Office of the President and who utilizes the services of the Buffalo Sewer Authority.

Sec. 25 "INDUSTRIAL WASTE" means the liquid, solid, and gaseous waste, including suspended solids resulting from the processes employed in industrial or commercial establishments.

Sec. 26 "INDUSTRIAL WASTE PERMIT" shall mean a permit to deposit or discharge industrial waste into any sanitary sewer under jurisdiction of the BSA.

Sec. 27 "INDUSTRIAL WASTE SURCHARGE" shall mean a charge, as outlined in the latest edition of the Buffalo Sewer Authority Sewer Rent Schedule, levied on industrial users of the sewerage treatment works for the additional cost of treating waste discharges of abnormal strength sewage. This charge includes capital, as well as operating and maintenance costs.

Sec. 28 "LATERAL SEWER" shall mean a sewer that discharges into a collecting sewer or other sewers and has no other common sewer tributary to it.

Sec. 29 "MAIN SEWER" shall mean a sewer that receives wastewater from the collecting sewer.

Sec. 30 "MAJOR CONTRIBUTING INDUSTRY" shall mean an industrial user of the publicly owned treatment works that: (a) has a flow of 50,000 gallons or more per average work day; or (b) has a flow greater than five percent of the flow carried by the municipal system receiving the waste; or (c) has in its waste a toxic pollutant in toxic amounts as defined in standards issued under section 307(a) of the Federal Water Pollution Control Act Amendments of 1972; or (d) is found by the Buffalo Sewer Authority, in connection with the issuance of a National Pollution Discharge Eliminations System Permit at the publicly owned treatment works receiving the waste, to have significant impact, as set forth in these Regulations, either singly or in combination with other contributing industries, on that treatment works or upon the quality of effluent from that treatment works.

Sec. 31 "mg/1" shall mean milligrams per liter.

Sec. 32 "MINOR CONTRIBUTING INDUSTRY" shall mean an industrial user of the publicly owned treatment facility that has a total discharge of less than 50,000 gallons per day on every day of the year and does not come under any of the provisions of Section 23 of this Article.

Sec. 33 "NATURAL OUTLET" shall mean any outlet into a watercourse, pond, ditch, lake or other body of surface or groundwater.

Sec. 34 "NORMAL STRENGTH SEWAGE" shall mean sewage which, when analyzed, by the BSA, shows by weight a daily average of not more than 2085 pounds per million gallons (250 parts per million) of suspended solids, and not more than 2085 pounds per million gallons (250 parts per million) of BOD and not more than 75.1 pounds per million gallons (9.0 parts per million) of chlorine demand, and 41.7 pounds per million gallons (5.0 parts per million) of phosphorus, and which is otherwise acceptable into a public sewer under the terms of these Regulations.

Sec. 35 "NPDES" shall mean the National Pollution Discharge Eliminations System.

Sec. 36 "OBJECTIONABLE WASTE" shall mean any wastes that can harm either the sewers, sewer treatment process, or equipment, have an adverse effect on the receiving stream, or otherwise endanger life, health, or property, or constitutes a nuisance.

Sec. 37 "P" (Total Phosphorus) shall mean the total quantity of phosphorus contained in a particular waste as determined by acceptable laboratory procedures, as set forth in Article VI, Section 11 hereof.

Sec. 38 "PERSON" shall mean any individual, firm, company, association, society, corporation or group, including a City, County, Town, Village, or Sewer District.

Sec. 39 "pH" shall mean the logarithm of the reciprocal of the weight of hydrogen ions in gram moles per liter of solution as determined by acceptable laboratory procedures as set forth in Article VI, Section 11 hereof.

Sec. 40 "POINT OF DISCHARGE" shall mean any discernible, confined and discrete conveyance or vessel from which pollutants are or may be discharged into a public waterway or public sewer system.

Sec. 41 "POLLUTED WATER OR WASTE" shall mean any water, liquid or gaseous waste containing any of the following: soluble or unsoluble substances of organic or inorganic nature which may deplete the dissolved oxygen content of the receiving stream; settleable solids that may form sludge deposits; grease and oils;

floating solids which may cause unsightly appearance; color; phenols and other substances to an extent which would impart any taste or odor to the receiving stream; and toxic or poisonous substances in suspension, colloidal state, solution or gasses.

Sec. 42 "ppm" shall mean parts per million.

Sec. 43 "PRETREATMENT" shall mean the treatment of wastewater before introduction into a publicly owned sewerage system.

Sec. 44 "PROPERLY SHREDDED GARBAGE" shall mean the wastes from the preparation, cooking, and dispensing of foods that have been shredded to such a degree that all particles will be carried freely under the flow conditions normally prevailing in public sewers, with no particle greater than one-half (½) inch (1.27 centimeters) in any dimension.

Sec. 45 "PUBLIC SEWER" means a publicly-owned sewer, storm drain, sanitary sewer or combined sewer.

Sec. 46 "RECEIVING WATERS" shall mean a natural water course or body of water into which treated or untreated sewage is discharged.

Sec. 47 "SANITARY SEWER" shall mean a sewer intended to receive domestic sewage and admissible industrial waste but to which storm, surface and groundwaters are not intentionally admitted.

Sec. 48 "SEWAGE" shall mean a combination of the water-carried wastes from residences, business buildings, institutions and industrial establishments, together with such ground, surface, and stormwaters as may be present.

Sec. 49 "SEWER" shall mean a pipe or conduit for carrying sewage.

Sec. 50 "SEWERAGE TREATMENT PLANT" shall mean any arrangement of devices and structures used for treatment of sewage.

Sec. 51 "SEWERAGE WORKS" shall mean all facilities for collecting, pumping, treating and disposing of sewage.

Sec. 52 "SHALL" is mandatory. "MAY" is permissive.

Sec. 53 "SLUG" shall mean any discharge of water, sewage or industrial waste which in concentration of any given constituent or in quantity of flow exceeds for any period of duration longer than fifteen (15) minutes more than five (5) times the average twenty-four hour concentration or flow during normal operation.

Sec. 54 "STANDARD METHODS" shall mean "Standard Methods for the

Examination of Water and Wastewater" prepared and published jointly by the American Public Health Association, American Waterworks Association and the Water Pollution Control Federation latest edition.

Sec. 55 "STORM DRAIN" (sometimes termed "storm sewer") shall mean a public sewer which carries storm and surface waters and drainage, but is not intended to carry sewage and industrial wastes, other than unpolluted cooling water.

Sec. 56 "STORMWATER" shall mean excess water which is derived from precipitation. This wuld include surface water.

Sec. 57 "SUSPENDED SOLIDS" shall mean solids that either float on the surface of, or are in suspension in water, sewage, or other liquids, and which are removable by acceptable laboratory procedures as set forth in Article VI, Section 11 hereof.

Sec. 58 "SURFACE WATER" shall mean the source of water which occurs when the rate of precipitation exceeds the rate at which water may infiltrate inot the soil.

Sec. 59 "THE ACT" shall mean Public Law 92-500.

Sec. 60 "TOXIC SUBSTANCES" shall mean any substance whether gaseous, liquid or solid which, when discharged to a public sewer in sufficient concentrations, may in the opinion of the General Manager, be hazardous to sewer maintenance and personnel, tend to interfere with any sewage treatment process, or to constitute a hazard to human beings or animals, or to inhibit aquatic life, or to create a hazard to recreation in the receiving waters of the effluent from a sewerage treatment plant.

Sec. 61 "TRUNK SEWER" shall mean a sewer constructed, maintained and operated by the Authority that conveys wastewater to the Authority's treatment facilities and into which lateral and collecting sewers discharge.

Sec. 62 "UNPOLLUTED WATER" shall mean water which is free of any polluted water or waste as described in Section 34 of this Article.

Sec. 63 "USER CHARGE" shall mean a charge leveid on users of sewerage treatment works for the capital cost, as well as the operation and maintenance of such works as outlined in the latest edition of the Buffalo Sewer Authority Sewer Rent Schedule.

Sec. 64 "WATERCOURSE" shall mean a channel in which a flow of water occurs, either continuously or intermittently.

Sec. 65 "WPCF" shall mean the Water Pollution Control Federation.

Sec. 66 "FLOW RATE" shall mean the quantity of waste or liquid that flows in a certain period of time.

Sec. 67 "FLOW VOLUME" shall mean the quantity of wastes or liquid.

ARTICLE II

GENERAL PROVISIONS

Sec. 1 PURPOSE

The purpose of these Regulations is to provide for the maximum possible beneficial public use of the Authority's facilities through regulations of sewer construction, sewer use and industrial wastewater discharges to provide for equitable distribution of the Authority's costs, and to provide procedures for complying with the requirements contained herein.

Sec. 2 SCOPE

These Regulations shall be interpreted in accordance with the definitions set forth in Article I hereof. The provisions of these Regulations shall apply to the direct or indirect discharge of all liquid carried wastes to facilities of the Authority. These Regulations, among other things provide for the regulation of sewer construction in areas within the jurisdiction of the BSA, the quantity and quality of discharged wastes, the degree of waste pretreatment required, the setting of waste discharge fees to provide for equitable distribution of costs, the approval of plans for sewer construction, the issuance of Permits for Industrial Wastewater Discharge and of other miscellaneous permits, and the establishment of surcharges and other procedures in cases of violaton of these Regulations.

Sec. 3 AREA AFFECTED

These Regulations shall apply to the City of Buffalo and those users outside the city who are by contract or agreements with the Buffalo Sewer Authority, users of the Authority's sewerage treatment works.

Sec. 4 ADMINISTRATION

Except as otherwise provided herein, the General Manager of the Buffalo Sewer Authority shall administer, implement and enforce the provisions of these Regulations.

Sec. 5 VIOLATION

Every person violating any provision of these Regulations, including the failure to pay any fees, charges or surcharges imposed hereby, or any condition or limitation of a permit or plan approval issued pursuant hereto, shall be assessed a special surcharge of five hundred dollars ($500), as provided in the Buffalo Sewer Authority Schedule of Sewer Rents and Other Charges.

Each day during which any violation continues shall constitute a separate violation. A day shall consist of a twenty-four hour period beginning at 12:01 AM and ending the following 12:01 AM.

The Buffalo Sewer Authority may, upon authorization of its Board, sue to recover any amounts due the Authority under the provisions of these Regulations.

Any person, who violates any provision of these Regulations pertaining to the subject matter of either subparagraphs (A) or (B) below, or any condition of limitation of a permit or plan approval related thereto shall be assessed a special surcharge as provided in the Buffalo Sewer Authority Schedule of Sewer Rents and Other Charges, in a sum not to exceed six thousand dollars ($6,000) for each day during which such violation continues.

(A) Under these Regulations, the pretreatment of any industrial waste which would be detrimental to the treatment works, or its proper and efficient operation and maintenance, is required as set forth in Article VI, Section 2, hereof.

(B) Under these Regulations, the prevention by the user of the entry of such untreated wastewater into the collecting system and treatment works is required.

When, in the opinion of the General Manager, or the Governmental Agencies, having jurisdiction in the matter, a violation of these Regulations is of such a nature as to be likely to cause damage to sewerage systems of the Buffalo Sewer Authority, or a menace to the health or safety of the inhabitants of any areas served, the Buffalo Sewer Authority may forthwith continue and sever any connections with its sewerage system without any liability for prosecution or damages.

Sec. 6 NOTICE

Any person found in violation of these Regulations or of any limitation or requirement of a permit issued hereunder, may be served, by the General Manager, with a written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction thereof. If satisfactory correcting action is not taken in the time allotted by the General Manager, action to implement Section 5 of this

Article shall be taken.

Unless otherwise provided herein, any notice required to be given by the General Manager under these Regulations shall be in writing and served in person or by registered or certified mail. The notice shall be sent to the last address of the violator known to the General Manager. Where the address is unknown, service may be made upon the owner of record of the property involved.

Sec. 7 TIME LIMITS

Any time limit provided in any written notice or in any provision of these Regulations may be extended only by a written directive of the General Manager.

Sec. 8 APPROVAL OF PLANS, ISSUANCE OF PERMITS AND CERTIFICATION OF FINAL INSPECTION

The General Manager will approve plans for sewerage works construction, issue a Permit for Industrial Wastewater Discharges or any other permit under these Regulations only if the sewerage construction, sewer connection, industrial wastewater discharge or other procedure conforms to the requirements of these Regulations.

The approval of plans, waste pretreatment process or the issuance of a permit by the General Manager, shall not relieve the discharger of his responsibility to maintain such pretreatment facilities so that its discharge meets all effluent requirements contained in these Regulations.

All required fees and charges shall be paid, before approval of plans or issuance of a permit will be made.

The General Manager reserves the right to inspect all work being constructed for the purpose of complying with these Regulations.

Sec. 9 FEES AND CHARGES

All fees and industrial waste charges payable under the provisions of these Regulations shall be paid to the Buffalo Sewer Authority. These charges shall be as outlined in the latest edition of the Buffalo Sewer Authority Sewer Rent Schedule.

Sec. 10 ESTIMATED QUANTITIES AND VALUES

Unless otherwise provided herein, whenever the fees and charges required by these Regulations are based on estimated values or estimated quantities the General Manager shall make such determinations in accordance with estimating practices heretofore used by the Buffalo Sewer Authority.

Sec. 11 PAYMENT OF CHARGES AND DELINQUENT CHARGES

All fees and charges imposed under the provisions of these Regulations, are due and payable upon receipt of the notice of charges. Unpaid charges shall become delinquent 45 days after mailing or delivering the notice of charges. A basic penalty charge of 10 percent of the unpaid amount shall be added to any fee or charge that becomes delinquent. Interest at the rate of one (1) percent per month shall accrue on the total of all delinquent charges including the 10% charge provided for herein.

Sec. 12 NEW INDUSTRIAL WASTEWATER DISCHARGES

All persons desiring to discharge industrial wastewater to the Buffalo Sewer Authority system must first obtain an Industrial Wastewater Discharge Permit issued by the General Manager of the Buffalo Sewer Authority.

Sec. 13 EXISTING INDUSTRIAL WASTEWATER DISCHARGES

All persons discharging industrial wastewater directly or indirectly to the Buffalo Sewer Authority sewerage system prior to the effective date of these Regulations and who have obtained prior approval of that industrial wastewater discharge are hereby granted a temporary permit to continue that discharge. This temporary permit shall expire six months after notification by the General Manager that a new permit must be obtained, or after two (2) years for the effective date of these Regulations, whichever shall occur first. Prior to the expiration of the temporary permit, the industrial wastewater discharger shall apply for and obtain a new permit for industrial wastewater discharge.

Sec. 14 PRETREATMENT STANDARDS

In compliance with Public Laws 84-660 and 92-500 of the Water Pollution Control Acts and amendments hereto, these Regulations adopt and use as a guide the national pretreatment standards and the Environmental Protection Agency's (EPA) pretreatment Guidelines. The Buffalo Sewer Authority recognizes that in some cases these pretreatment standards may not be sufficient to protect the operation of its treatment works, or make it unable to comply with the terms of its NPDES permit. In such cases, the Buffalo Sewer Authority reserves the right to impose more stringent pretreatment standards, than those specified in the EPA regulations.

Sec. 15 INSPECTIONS

The General Manager of the Buffalo Sewer Authority, EPA, County and State Environmental Conservation Department representives, bearing proper credentials and identification shall be permitted to enter upon all properties for the purpose of inspection, observation, measurements, sampling and testing in accordance with the provisions of these regulations.

Sec. 16 EFFECTIVE DATE OF REGULATIONS

The effective date of these Regulations is __________.

Sec. 17 SUPERSEDING PREVIOUS REGULATIONS

These Regulations governing Sewer Construction, Sewer Use and Industrial Wastewater Discharges shall supersede all previous regulations of the Buffalo Sewer Authority.

ARTICLE III

SANITARY FACILITIES REQUIRED

Sec. 1 CONNECTIONS

Sanitary facilities for all structures in the City of Buffalo shall be provided in accordance with Chapter XI of the Ordinances of the City of Buffalo "Buffalo Housing and Property Code", Chapter XII of the Ordinances of the City of Buffalo "Buffalo Building Code" and Chapter XXV of the Ordinances of the City of Buffalo "Buffalo Health Ordinance" and shall be connected with the facilities of the Authority.

Sec. 2 BUILDING CONNECTIONS

Building service sewers to residential, commercial or industrial buildings shall be required in accordance with applicable ordinances and with the Plumbing Code of the City of Buffalo adopted by the Examining Board of Plumbers on February 4, 1957, and approved by the Erie County Health Department on April 2, 1957, as the same may be amended from time to time, and all other sewer construction shall be governed by said Code and other Ordinances.

Sec. 3 PRIVATE DISPOSAL SYSTEM

Where a public sanitary or combined sewer is not available, a private sewage disposal system shall be required, and shall be installed in accordance with all laws of the State of New York, Ordinances of the City of Buffalo and regulations of the Department of Health of the State of New York. This installation shall be subject to the approval of the Commissioner of Health of the County of Erie, and shall be maintained and operated in a sanitary manner.

Sec. 4 EXISTING CONNECTIONS

Existing connections to the combined system will be allowed to function in their present form until such time as a separate sanitary sewer shall be constructed, at which time all sanitary sewer outlets shall be required to be connected thereto.

It is one explicit purpose of this Regulation, by the application and enforcement thereof to deter, prevent and eliminate, as far as possible, the introduction of storm waters into the BSA trunk sewer system and all public sewers tributary thereto. However, it is recognized that in certain areas the immediate and strict application and enforcement of these Regulations against existing and established connections would not be feasible.

This statement shall not be construed to mitigate in any way the application and enforcement of these Regulations against the construction of any new combined sewers and against any new connections discharging storm water to the BSA trunk sewer system and public sewers tributary thereto. Nor shall this statement of policy be construed to be used as a defense against any changes which may be ordered by state or federal regulatory agencies.

Sec. 5 SEPTIC SYSTEMS

Except as hereinafter provided, it shall hereafter be unlawful to construct or maintain any privy, privy unit, septic tank, cesspool, or other facility intended or used for the disposal of sewage. If application is made to the General Manager of the Buffalo Sewer Authority for a temporary type toilet facility, and if said applicant has theretofore obtained the approval of the Erie County Health Department, the said General Manager of the Buffalo Sewer Authority may consent to the usage of the same for a temporary period not to exceed 180 days.

Sec. 6 OTHER LAWS, RULES AND REGULATIONS

These Regulations are in addition to the applicable Ordinances of the City of Buffalo, the codes and regulations of the County of Erie and the laws, rules and regulations of the State of New York and the United States. Where such laws, codes, rules and regulations contain provisions more restrictive than those contained in these Regulations, the former shall apply.

ARTICLE IV

CONSTRUCTION OF SEWERS AND CONNECTIONS

Sec. 1 PERMITS

No person shall uncover, make any connections with or opening into, use, alter, or disturb any public sewer or appurtenance thereof without first obtaining a written permit for the City of Buffalo, Division of Engineering, with the approval of BSA endorsed thereon, for such connection and, if required, pay either a permit fee or connection charge.

Sec. 2 PERMIT CHARGES

A permit and inspection fee of $25.00 for a residential or commercial building sewer permit, and, $50.00 for an industrial building sewer permit shall be paid to the BSA at the time the application for the permit is filed. These charges are intended to cover the administrative costs of processing the application. Other charges and fees are outlined in BSA's latest edition of "The Schedule of Sewer Rents and Other Charges".

Sec. 3 NOTIFICATION OF COMPLETION

The applicant for the building sewer permit shall notify the BSA Principal Engineer when the building sewer is ready for inspection and connection to the public sewer. The connection shall be made under the supervision of the Buffalo Sewer Authority.

Sec. 4 JOINTS

Every joint in the connection to a sanitary sewer shall conform to the New York State Department of Environmental Conservation requirements and be made water tight so that no leakage into or out of such connections shall occur.

Sec. 5 INSPECTION

No sewerage facility, other than building service sewers, shall be constructed in the City of Buffalo except by the Buffalo Sewer Authority, or by others in accordance with plans and specifications approved by the Buffalo Sewer Authority, and subject to inspection during construction by Engineers and employees of the Buffalo Sewer Authority. No sanitary or storm sewer shall be considered to be a part of the public sewerage system of the City of Buffalo unless the Board of the Buffalo Sewer Authority duly adopts a resolution of completion and acceptance thereof.

Sec. 6 EXPIRATION OF PLANS

An approval of plans for construction of sewerage facilities shall expire one year after the date of approval unless construction has been initiated and completed within a reasonable time thereafter.

Sec. 7 SPECIAL DRAINS

Drains receiving acid waste shall be constructed of acid resisting material. Such drains located outside of a building shall be constructed of vitrified clay or earthenware pipe or other approved acid resisting material. Joints shall be constructed by caulking with asbestos rope wicking and by pouring a heated sulphur and carbon compound or a heated bituminous compound in such a manner as to secure tight joints.

Sec. 8 CLASSES OF PERMITS

There shall be two (2) classes of sewer permits: (a) for residential and commercial service and (b) for service to establishments producing industrial wastes. In either case, the owner or his agent shall make application on a special form furnished by the Buffalo Sewer Authority. The permit application shall be supplemented by any plans, specifications, or other information considered pertinent in the judgement of the General Manager.

Sec. 9 CONNECTION COSTS

All costs and expense incident to the installation and connection of the building service sewer shall be borne by the owner. The owner shall indemnify the City of Buffalo and the Buffalo Sewer Authority from any loss or damage that may directly or indirectly be occasioned by the installation of the building service sewer.

Sec. 10 SEPARATE CONNECTIONS

A separate and independent building service sewer shall be provided for every building in residential and commercial areas, except that where one building stands at the rear of another on an interior lot, and no private sewer is available, or can be constructed to the rear building through an adjoining alley, court, yard, or driveway, the building service sewer from the front building may be extended to the rear building and the whole considered as one building service sewer.

Sec. 11 USE OF EXISTING SEWERS

Old building service sewers may be used in connection with new buildings only when they are found, on examination by the BSA Principal Engineer, to meet all requirements of these Regulations.

Sec. 12 SPECIFICATIONS

The size, slope, alignment, materials of construction of a building service sewer, and the methods to be used in excavating, placing of the pipe, jointing, testing and backfilling the trench, shall all conform to the requirements of the building and plumbing code or other applicable rules and regulations of the City of Buffalo. In the absence of code provisions or in amplification thereof, the materials and procedures set forth in appropriate specifications of the ASTM and WPCF Manual of Practice No. 9 (Design and Construction of Sanitary and Storm Sewers) shall apply.

Sec. 13 ELEVATION OF SEWERS

Whenever possible, the building service sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which below floor building drains are too low to permit gravity flow to the public sewer, sanitary sewage carried by such building drains shall be lifted by means established in standard engineering practice to a suitable level and then discharged to the building service sewer, or the building drain may be hung on the cellar wall and shall not be less than four (4) inches in diameter.

Sec. 14 CONNECTION OF ROOF AND FOUNDATION DRAINS

No person shall make connection of roof downspouts, exterior foundation drains, areaway drains, or any other sources of surface runoff or groundwater to a building service sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer.

Sec. 15 PUBLIC SAFETY

All excavations for building service sewer installation shall be adequately guarded with barricades and lights so as to protect the public from hazard. Streets, sidewalks, parkways and other public property disturbed in the course of the work shall be restored by the Permittee in a manner satisfactory to the City of Buffalo.

ARTICLE V

USE OF PUBLIC SEWERS

GENERAL

Sec. 1 INDUSTRIAL WASTEWATER DISCHARGES PROHIBITED

No industrial wastewaters shall be discharged to a trunk sewer or to a sewer discharging directly or indirectly to a trunk sewer until a Permit for Industrial Wastewater Discharge has been approved by the General Manager.

Sec. 2 DISCHARGE OF WATERS NOT CONTAINING SEWAGE

The discharge of waters not containing sewage is prohibited. Except with the approval of the General Manager, or as otherwise provided in these Regulations, no storm water connection from any building or yard, nor any drain from any catch basin, lake, swamp, pond, or swimming pool, nor any outlet for surface water, storm water or ground water of any kind shall be connected to the BSA trunk sewer system or any public sewer tributary thereto or to any private sewer connected to any such public sewer.

Within any area served by a separate sanitary sewer and a storm sewer, no storm water shall be allowed to enter soil, waste or vent pipes from any building. Within any such area no down spout, roof leaders, gutters, other pipes, or drains such as channels which may at any time carry storm water surface drainage derived from hydraulic pressure or from well points, cooling water or lake water shall be connected with any sanitary sewer, but must be connected to said storm sewer.

Sec. 3 DISCHARGE TO A NATURAL OUTLET

It is prohibited to discharge to any storm sewers or natural outlet within the area served by the Buffalo Sewer Authority any sewage or other polluted waters, except where suitable treatment has been provided in accordance with the provisions of these Regulations, and except where a Federal National Pollutant Discharge Elimination Systems (NPDES) permit has been duly issued and is currently valid for such discharge. A valid copy of such a permit and any modifications thereof must be filed with the General Manager for an exception under this section of these Regulations.

Sec. 4 COOLING WATER DISCHARGE

The discharge of industrial cooling water or unpolluted process waters to a storm sewer, combined sewer or a natural outlet without the approval of the General Manager is prohibited.

Sec. 5 PROHIBITED DISCHARGES

No person shall discharge or cause to be discharged any of the following described waters or wastes to any public sewers or natural outlets:

(a) Any gasoline, benzene, maphtha, fuel oil, or other flammable or explosive liquid, solid or gas.

(b) Any waters used for the purpose of diluting wastes which would exceed applicable maximum concentrations limitations.

(c) Any water or wastes having a pH lower than 5.5, or having a pH higher than 9.5- or having any other corrosive property capable of causing damage or hazard to structures, equipment of the sewer system, or personnel employed in its operation.

(d) Solid or viscous substances in quantities or of such size as to be capable of causing, obstruction to the flow in sewers or otherwise interfering with the proper operation of the sewage works such as, but not limited to, ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, unground garbage, whole blood, paunch manure, hair and fleshings, entrails, paper dishes, cups, milk containers, etc., either whole or ground by garbage grinders.

(e) Any waters or wastes containing toxic or poisonous solids, liquids, or gases in sufficient concentration in the opinion of the General Manager either singly or by interaction with other wastes, to injure or interfere with any sewage treatment process, or to constitute a hazard to humans or animals or to create a public nuisance, or to create any hazards in the receiving waters of a sewage treatment plant effluent.

(f) Wastes, other than domestic sewage, from any hospital, mercantile, manufacturing or industrial establishment, or any steam, hot gases or vapors, grease fats, oils, acids, carbon, iron or mineral wastes, or any other wastes which would tend to obstruct the public sewer, to be injurious to the public health, create odors, be determental to the sewerage works, or which would interfere with the proper repair or maintenance of the sewerage system, the operation and maintenance of the disposal works or the proper treatment of domestic sewage, or which results after treatemnt in an effluent which is a menace to life or health.

Sec. 6 LIMITED DISCHARGES

No person shall discharge or cause to be discharged into the public sewerage system or into a natural outlet, the following described substances: materials, waters, or wastes, if it appears likely in the opinion of the General Manager, that such wastes are likely to harm the public sewers, sewage treatment process, or equipment, have an adverse effect on the receiving stream, or is likely to otherwise endanger life, health or property, or constitute a nuisance. In forming his opinion as to the acceptability of these wastes, the General Manager will give consideration to such factors as the quantities of subject wastes in relation to flows and velocities in the sewers, materials of which the sewer is constructed, nature of the sewage treatment process, capacity of the sewage treatment plant, degree of treatability of wastes in the sewage treatment plant and other factors which are pertinent in the opinion of the General Manager. The substances prohibited are:

(a) Any liquid or vapor having a temperature higher than one hundred fifty (150°F) (65°C). If, in the opinion of the General Manager, lower temperatures of such wastes could harm either the sewers, sewage treatment process, or equipment, have an adverse effect on the receiving stream, or could otherwise endanger life, health or property, or constitute a nuisance, the General Manager may prohibit such discharges.

(b) Any water or waste containing fats, wax, grease, or oils, whether emulsified or not, in excess of fifty (50) mg/l or containing substances which may solidify or become viscous at temperatures between thirty-two (32)°F or (0)°C and one hundred fifty (150)°F and (65)°C.

(c) Any garbage that has not been properly shredded. The installation and operation of any garbage grinder equipped with a motor of three -fourths (3/4) horse power (0.76 hp metric) or greater shall be subject to the review and approval of the General Manager.

(d) Any waters or wastes containing heavy metals and similar objectionable or toxic substances to such degree that any such material received in the composite sewage at the Point of Discharge exceeds the limits established below:

Chromium (Total)	2.0 mg/l
Chromium (Trivalent)	1.0 mg/l
Chromium (Hexavalent)	0.1 mg/l
Copper	0.4 mg/l
Zinc	0.6 mg/l
Nickel	1.0 mg/l
Cadmium	0.2 mg/l
Arsenic	0.1 mg/l

Barium	1.0 mg/l
Lead	0.1 mg/l
Manganese	1.0 mg/l
Silver	.05 mg/l
Boron	1.0 mg/l
Mercury	.01 mg/l
Selenium	.05 mg/l

or any element which will in the opinion of the General Manager, damage collection facilities or be detrimental to the treatment processes. The limits set forth above amy be amended from time to time as such amendment is deemed necessary by the General Manager to protect the facilities or life or health.

(e) Any water or wastes that contain phenolics in excess of 0.1 parts per million by weight, or other taste or odor producing substances in such concentrations exceeding limits established by the General Manager.

(f) Any radioactive wastes or isotopes of such half-life or concentrations as may exceed limits established by the General Manager in compliance with applicable State, Federal, or other public agencies having jurisdiction.

(g) Quantities of flow, concentrations, or both, which constitute a "slug" as defined herein.

(h) Materials which cause:

1. Unusual concentrations of inert suspended solids which are defined as concentrations exceeding 250 ppm or dissolved solids such as but not limited to, sodium chloride in concentrations greater than 10,000 ppm and sodium sulfate in concentrations greater than 500 ppm.

2. Unusual concentrations of BOD which are defined as concentrations exceeding 250 ppm, chlorine requirements exceeding 9.0 ppm or phosphorus concentrations exceeding 5.0 ppm.

3. Discolorations, such as, but not limited to dye waters and vegetable tanning solution.

In cases where the effluent characteristics of an industrial or commercial discharge exceeds the maximum permissible limits stated above, the acceptability of such waste will be left to the engineering judgement of the General Manager. If in the judgement of the General Manager the admission of such wastes will not overload the Authority's facilities, a permit to discharge said waste may be granted. However, the Authority may require the payment of an industrial waste surcharge for both capital and operating and maintenance expenses to cover the cost of treatment for the abnormal strength sewage.

(i) Waters or wastes containing substances which are not amenable to treatment or reduction by the sewage treatment processes employed, or are amenable to treatment only to such degree that the sewage treatment plant effluent cannot meet the requirements of State, Federal or other agencies having jurisdiction over discharge into the receiving waters.

(j) Any waters or wastes which by interaction with other waters or wastes in the public sewerage system release odors, form suspended solids which interfere with the collection system or create a condition deleterious to the sewerage works.

(k) Any waste with a concentration of cyanide in excess of 0.8 mg/1.

(1) Any waste containing any substance that may precipitate, solidify, or become viscous at temperatures between 40°F and 100°F.

Sec. 7 IMPROPER USE OF SEWERS

The Buffalo Sewer Authority hereby reserves the right to inspect any existing building service sewer and drain, lateral or collecting sewers that discharge wastewater directly or indirectly to the Authority's facilities. If it is found that such laterals or collecting sewers are used or maintained in such a way as to cause discharge of septic wastewater or ground water or debris which exceeds the design criteria of said sewer or any other substance deemed objectionable by the General Manager, the General Manager will give notice of the unsatisfactory condition to the discharger and shall direct that the condition be corrected.

In cases of continued non-compliance with the General Manager's directive, the Buffalo Sewer Authority may disconnect the said sewer from the Authority's sewerage system without any liability for prosecution or damages.

Sec. 8 EXCESSIVE SEWER MAINTENANCE EXPENSE

No person shall discharge or cause to be discharged to a trunk sewer, either directly or indirectly, any waste that creates a stoppage, plugging, breakage, any reduction in sewer capacity or any other damage to sewers or sewerage facilities of the Authority. Any additional sewer or sewerage maintenance expenses caused by such a discharge, or any other expenses attributable thereto will be charged to the discharger by the Authority.

Any refusal to pay the additional maintenance expenses duly authorized by the General Manager shall constitute a violation of these Regulations. The charge shall be determined as outlined in the latest edition of the BSA's Schedule of Sewer Rents and Other Charges.

ARTICLE VI

INDUSTRIAL WASTEWATER

Sec. 1 PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE

No person shall discharge, or cause to be discharged, any industrial wastewaters directly or indirectly to sewerage facilities owned by the Buffalo Sewer Authority without first obtaining a Buffalo Sewer Authority Permit for Industrial Wastewater Discharge. As a condition for issuance of a Permit, the BSA may require that any user of the Authority's facilities shall enter into a contractual agreement for a period of one year with provisions for renewal of such agreements as may be required by the General Manager.

If the volume or character of the waste to be treated is determined by the BSA not to cause overloading of the sewage collection, treatment, or disposal facilities of the BSA, then prior to approval, the General Manager and the person making the discharge shall enter into an agreement which provides that the discharger pay a sewer rent or industrial waste charge, as outlined in the latest edition of "The Schedule of Sewer Rents and Other Charges".

If the volume or character of the waste to be treated by the BSA requires that wastewater collection, treatment, or other disposal facilities of the Authority be improved, expanded, or enlarged in order to treat the waste, then prior to approval, the BSA and the person making the discharge shall enter into an agreement which provides that the discharger pay in full all added costs the Authority may incur due to acceptance of the waste.

The Permit for Industrial Wastewater Discharge may require pretreatment of industrial wastewaters before discharge, restriction of peak flow discharges, discharge of certain wastewaters only to specified sewers, relocation of points of discharge, prohibition of discharge of certain wastewater components restriction of discharge to certain hours of the day, payment of additional charges to defray increased costs of the Authority created by the wastewater discharges and such other conditions as may be required to effectuate the purpose of these Regulations.

No Authority Permit for Industrial Wastewater Discharge is transferable without the prior written consent of the General Manager.

No person shall discharge industrial wastewaters in excess of the quantity or quality limitations set by his Permit for Industrial Wastewater Discharge. Any person desiring to discharge wastewaters or use facilities which are not in conformance with its Industrial Wastewater Permit must apply to the General Manager for an amended Permit. Such amended Permit shall be granted provided its terms shall comply with these regulations.

It is the explicit purpose of this Article to achieve the following:

(a) Protect the operation of the publicly owned sewerage works,

(b) To prevent inadequately treated pollutants from passing through said works, and

(c) To insure the Buffalo Sewer Authority's compliance with their NPDES Permit.

Sec. 2 APPLICABILITY

The standards and procedures set forth in this Article apply to all industrial users of the Buffalo Sewer Authority sewerage system.

Where an industrial user qualifies as a major contributing industry, EPA's Effluent Guidelines and Standards will determine the characteristics of permissible waste discharges and the degrees of pretreatment required. In cases where the General Manager deems it necessary to impose more stringent requirements, or where removals within the system permit less stringent requirements, and where no EPA guidelines exists, the provisions of Article V (Use of Public Sewer-General) of these Regulations shall apply.

Sec. 3 PROCEDURE FOR OBTAINING A PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE

Applicants for a Permit for Industrial Wastewater Discharge shall complete a Buffalo Sewer Authority application form available in the appendix of these Regulations or at the Buffalo Sewer Authority offices, Room 1030, City Hall.

Upon receipt of all required information, the application shall be processed. When properly executed by the BSA, the application form shall constitute a valid Permit for Industrial Wastewater Discharge.

The application shall be approved if the applicant has complied with all applicable requirements of these Regulations.

Sec. 4 CHANGES OF INDUSTRIAL WASTEWATER PERMIT RESTRICTIONS

As EPA adds or amends specific pretreatment and effluent guidelines, or as the Buffalo Sewer Authority deems necessary, the restrictions or conditions of a Permit for Industrial Wastewater Discharge may require amendment, as circumstances dictate. The Buffalo Sewer Authority shall require an industrial discharger to establish an abatement time schedule to comply with any changes in the Industrial Wastewater Permit.

Sec. 5 SUSPENSION OF PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE

The General Manager may suspend a Permit for Industrial Wastewater Discharge when such suspension is necessary in the opinion of the General Manager, in order to stop a discharge which presents a hazard to the public health, safety or welfare, to the environment, or the Authority's sewerage system.

Any discharger notified of a suspension of his Industrial Wastewater Permit shall immediately stop the discharge of all industrial wastewater to the BSA system. In the event of a failure of the discharger to comply voluntarily with the suspension order, the General Manager shall take such steps persuant to Article II, Section 5 as he deems necessary to insure compliance.

The General Manager shall reinstate the Industrial Wastewater Permit upon proof of satisfactory compliance with all discharge requirements of these Regulations.

Sec. 6 REVOCATION OF PERMIT FOR INDUSTRIAL WASTEWATER DISCHARGE

The General Manager may revoke a Permit for Industrial Wastewater Discharge upon a finding that the discharger has violated any provision of these Regulations.

Any discharger whose Industrial Wastewater Permit has been revoked shall immediately stop all discharge of any liquid carried wastes covered by the Permit to any public sewer that is tributary to a sewer or sewerage system of the Authority. The General Manager may disconnect or permanently block from such public sewer the industrial connection of any discharger whose Permit has been revoked, if such action is necessary to insure compliance with the order of revocation.

Before any further discharge of industrial wastewater may be made by the discharger, he must apply for a new Permit for Industrial Wastewater Discharge, pay all charges that would be required upon initial application together with all delinquent fees, charges and such other sums as the discharger may owe to the Authority. Costs incurred by the Authority in revoking the Permit and disconnecting the industrial sewer shall be paid for by the discharger before issuance of a new Permit.

Sec. 7 PROHIBITED WASTE DISCHARGES

In most cases, the concentration or amounts of any particular constituent which will be judged to be excessive or unreasonable cannot be foreseen, but will depend on the results of technical determination and action of regulatory agencies. A partial list of these constituents appear in Article V of these Regulations. However, as new regulations and requirements are promulgated by Federal and State authorities, they too will become part of these Regulations.

Sec. 8 INDUSTRIAL WASTEWATER SURCHARGE

As a condition of the Industrial Waste Permit, an industry may be required to pay an industrial waste surcharge. The payment of the surcharge shall, at a minimum, occur annually. This surcharge will be required from those industrial wastewater dischargers whose contribution of compatible pollutants create costs in excess of that normally created by a domestic user. The surcharge shall be based on the Authority's annual debt service and total operating and maintenance costs for providing industrial wastewater collection, treatment and disposal services. The actual charges and formula for determining these charges are outlined in the Buffalo Sewer Authority's Schedule of Sewer Rents and Other Charges.

Sec. 9 PRETREATMENT OF INDUSTRIAL WASTEWATERS

An Industrial Wastewater Pretreatment System may be required by the General Manager to treat industrial flows prior to discharge to the BSA system when it is necessary to measure, sample, restrict or prevent the discharge to the sewer of certain waste constituents, to more equally distribute peak discharges of industrial wastewater, or to accomplish any pretreatment result required by the General Manager. All pretreatment systems shall be subject to the approval of the Sewer Authority, but such approval shall not relieve the industrial dischargers of the responsibility of meeting any required industrial effluent limitations. All pretreatment systems shall be adequately engineered and designed to the satisfaction of the General Manager and all reports and plans shall have been prepared and signed by a professional engineer licensed in the State of New York.

Sec. 10 CONTROL MANHOLE

As a condition of the Industrial Waste Permit, when required by the General Manager, the owner of any property serviced by a building service sewer, carrying wastewater shall install a suitable control manhole together with such meters and other appurtenances deemed necessary by the General Manager to adequately sample and measure the waste passing through the control manhole. This control manhole shall be located so as to permit unrestricted access by representatives of the Authority. The control manhole may be used as a junction manhole for domestic sewage and industrial waste providing the junction occurs downstream of the sampling or flow measuring point.

Sec. 11 INDUSTRIAL WASTEWATER SAMPLING, ANALYSIS AND FLOW MEASUREMENTS

Periodic measurements of flow rates, flow volumes, BOD, P, chlorine demand and suspended solids for use in determining the annual industrial wastewater treatment charges, and such measurements of other constituents deemed necessary by the General Manager, shall be made on all industrial wastewater discharges, unless specifically relieved of such obligation by the Authority. All sampling, analysis and flow measurements of industrial wastewaters shall be performed by an independent laboratory, or by a laboratory of an industrial discharger, approved by the General Manager. If performed by the Sewer Authority personnel, an appropriate charge shall be paid by the discharger requesting the tests. The charges are outlined in the latest edition of the Schedule of Sewer Rents and Other Charges. Prior to submittal to the Authority of data developed in the laboratory of an industrial discharger, the results shall be verified by a responsible administrative official of the industrial firm or corporation.

All wastewater analysis shall be conducted in accordance with the appropriate procedure contained in EPA's "Methods of Analysis of Water and Wastes", 1971(most recent edition) or "Standard Methods". If no appropriate procedure is contained therein, the standard procedure of the industry, or a procedure judged satisfactory by the General Manager, shall be used to measure wastewater constituents. Any independent laboratory or discharger performing tests, shall furnish the required test data or information on the test methods or equipment used, if requested to do so by the General Manager.

All dischargers making periodic measurements shall furnish and install at the control manhole, or other appropriate location, a calibrated flume, weir, flow meter or similar device approved by the General Manager, and suitable to measure the industrial wastewater flow rate and total volume. A flow indicating, recording, and totalizing register may be required by the General Manager. In lieu of wastewater flow measurement, the General Manager may accept records of water usage and adjust the flow volumes by suitable factors to determine peak and average flow rates for the specific industrial wastewater discharge.

The sampling, analysis and flow measurement procedures, equipment and results shall be subject at any time to inspection of the Authority.

When required by the General Manager, dischargers shall install and maintain in proper order, automatic flow-proportional sampling equipment and/or automatic analysis and recording equipment.

Measurements to verify the quantities of waste flows and waste constituents reported by industrial discharges will be conducted on a random basis by personnel of the Authority.

Sec. 12 DISCREPANCIES BETWEEN ACTUAL AND REPORTED INDUSTRIAL WASTEWATER DISCHARGE QUANTITIES

In the event a discharger fails to report changes in his discharge characteristics to the General Manager, and should measurements and other investigations reveal that a discharger is discharging a flow rate, flow quantity, or waste exhibiting waste characteristics in concentrations in excess of that stated on their Industrial Waste Permit, the discharger must then apply for an amended Industrial Wastewater Permit. If the erroneous data reported to the Authority by the discharger was used as a basis for an industrial waste treatment charge, the discharger shall be assessed for all delinquent charges together with the additional 10% charge and interest provided for in Article II. Before additional charges shall be assessed or the permit amended at least two (2) additional 24-hour samples and flow measurements shall be obtained by the Authority or by another independent laboratory acceptable to both parties, with all costs of sampling and analysis to be paid by the discharger.

For the purpose of establishing the correct treatment surcharge, the data obtained in these samplings, along with any other relevant information obtained by the Authority or presented by the discharger, shall be used by the General Manager in determining the quantity parameters for use in the formula. An industrial discharger found in violation, shall in the absence of other evidence by presumed to have been discharging at the determined parameter values over the preceeding year, or subsequent to the previous Authority verification of quantity parameters, whichever period is shorter.

Sec. 13 DAMAGE CAUSED BY PROHIBITED WASTEWATER DISCHARGE

Any industrial wastewater discharger who discharges, or causes the discharge, of prohibited wastewaters which cause damage to the Authority's facilities, detrimental effects on treatment processes or any other damages resulting in costs to the Sewer Authority, shall be liable for all damages occasioned thereby.

Sec. 14 TRUCKERS DISCHARGE PERMIT

All persons owning vacuum or "cesspool" pump trucks, or other liquid transport trucks, and desiring to discharge septic tank, seepage pit, interceptor or cesspool contents, industrial liquid waste or other liquid wastes to sewerage facilities of the Authority, or to facilities that discharge directly or indirectly to such sewerage facilities, shall first have a valid Sewer Authority Trucker's Discharge Permit. All applicants for a Trucker's Discharge Permit shall complete the application form, pay the appropriate Permit fee, receive a copy of the Sewer Authority Regulations governing discharge to sewers, of liquid wastes from trucks and shall agree, in writing, to abide by these Regulations.

Discharge of septic tank, seepage pit, interceptor or cesspool contents or other wastes containing no industrial wastes, may be made by truckers holding a Permit at any of the designated public dumping manholes. Truck transported industrial wastes shall be discharged only at the locations specified by the General Manager for the specific waste. The Sewer Authority shall require payment for treatment and disposal costs fo the compatible industrial waste, or may refuse permission to discharge prohibited wastes.

The Trucker's Discharge Permit shall be valid for one (1) year from date of issuance.

Any person violating the Authority's requirements for liquid waste discharges from trucks may have his Permit revoked by the General Manager.

APPENDIX C

PILOT PLANT INVESTIGATIONS BACKGROUND DATA

Table

C-1 November's Pilot Plant Operational Data
C-2 December's Pilot Plant Operational Data
C-3 Daily Trace Element Concentrations
C-4 Waste Primary Sludge Characteristics
C-5 Waste Secondary Sludge Characteristics

Figure

C-1 Daily Cadmium Variation
C-2 Daily Chromium Variation
C-3 Daily Copper Variation
C-4 Caily Cyanide Variation
C-5 Daily Lead Variation
C-6 Daily Nickel Variation
C-7 Daily Zinc Variation

Table C-1. NOVEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	Total C.O.D.					Soluble C.O.D.					Flow 10^3 gpd	Precp in.	Total B.O.D.					Soluble B.O.D.				
		mg/l			% Removal		mg/l			% Removal				mg/l			% Removal		mg/l			% Removal	
		Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total			Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total
1	Fr	263.7	-	70.8	-	73.2	114.1	-	59.0	-	48.3	11.9		72.9	-	11.4	-	84.4	-	-	6.5	-	-
2	Sa	236.4	-	81.4	-	65.6	96.9	-	50.4	-	48.0	9.9		87.9	-	14.3	-	83.7	-	-	7.1	-	-
3	Su	221.8	-	81.7	-	63.2	81.7	-	50.6	-	38.1	12.8		76.5	-	15.8	-	79.3	26.5	-	8.5	-	67.9
4	M	214.1	-	62.3	-	70.9	105.1	-	46.7	-	55.6	8.5		91.5	-	14.5	-	84.2	41.0	-	6.4	-	84.4
5	Tu	187.6	-	85.9	-	54.2	93.8	-	46.9	-	50.0	9.1		56.7	-	15.0	-	73.5	-	-	-	-	-
6	W	239.0	-	82.3	-	65.6	113.7	-	51.0	-	55.1	10.1		79.5	-	16.5	-	79.2	41.0	-	3.5	-	91.5
7	Th	229.6	-	46.7	-	79.7	-	-	-	-	-	12.7		78.0	-	10.0	-	87.2	44.0	-	5.6	-	87.3
8	Fr	246.1	-	78.2	-	68.2	132.9	-	46.9	-	64.7	12.9		77.1	-	8.4	-	89.1	38.0	-	6.0	-	84.2
9	Sa	269.7	-	66.4	-	75.4	78.2	-	27.4	-	65.0	13.4		64.3	-	9.6	-	85.1	27.8	-	5.1	-	81.7
10	Su	220.0	-	77.2	-	64.9	100.4	-	42.5	-	57.7	14.6		78.0	-	16.5	-	78.8	37.0	-	7.2	-	80.5
11	M	238.6	-	76.9	-	67.8	92.4	-	46.2	-	50.0	12.7		97.5	-	13.5	-	86.2	54.0	-	6.0	-	88.9
12	Tu	242.3	-	76.9	-	68.3	115.4	-	57.7	-	50.0	12.7		85.7	-	13.2	-	84.6	44.1	-	4.0	-	90.9
13	W	154.1	-	55.3	-	64.1	79.1	-	39.5	-	50.1	13.6		42.0	-	7.5	-	82.1	21.6	-	3.6	-	83.3
14	Th	136.2	-	42.8	-	68.6	54.5	-	35.0	-	35.8	13.2		33.0	-	8.7	-	73.6	14.0	-	4.3	-	69.3
15	Fr	108.9	-	58.4	-	46.4	77.8	-	46.7	-	40.0	10.8		33.0	-	11.0	-	66.7	30.0	-	3.6	-	88.0
16	Sa	112.8	-	66.1	-	41.4	73.9	-	50.6	-	31.5	12.8		34.5	-	16.2	-	53.0	20.4	-	8.0	-	60.8
17	Su	97.7	-	46.9	-	52.0	54.7	-	31.3	-	42.8	13.9		19.5	-	7.5	-	61.5	18.0	-	3.6	-	80.0
18	M	88.6	-	42.8	-	51.7	54.5	-	27.2	-	50.1	14.8	0.0	21.6	-	6.8	-	80.6	13.5	-	4.2	-	68.9
19	Tu	244.2	194.0	73.6	20.6	69.9	89.1	96.9	46.5	-	47.8	29.6	0.27	48.0	51.0	12.0	-	75.0	25.2	33.0	7.5	-	70.3
20	W	177.1	102.0	59.0	42.4	66.7	59.0	55.1	39.4	6.6	33.2	30.6	0.99	28.0	27.6	9.0	1.4	67.4	14.4	14.3	4.2	0.7	70.8
21	Th	126.5	118.6	39.5	6.2	68.8	75.1	55.3	19.8	26.4	73.6	33.2	0.10	32.5	33.0	6.2	-	80.9	22.8	24.4	6.6	-	71.1
22	Fr	173.2	153.5	47.2	11.4	72.7	90.5	106.3	23.6	-	73.9	25.3	0.00	59.3	36.0	6.0	39.3	89.9	-	-	-	-	-
23	Sa	200.7	145.6	31.5	27.5	84.3	-	-	-	-	-	24.6	0.00	68.3	33.0	5.4	51.7	92.1	-	-	-	-	-
24	Su	113.3	86.0	50.8	24.1	55.2	62.5	66.4	39.1	-	37.4	21.2	0.74	33.5	24.8	6.5	26.0	80.6	-	-	-	-	-
25	M	196.0	176.4	62.7	10.0	68.0	117.6	101.9	47.0	13.4	60.0	27.6	0.00	42.6	30.6	3.8	28.2	91.1	28.5	19.9	2.3	30.2	91.9
26	Tu	203.8	173.6	41.6	14.8	79.6	101.9	90.6	30.2	11.1	70.4	22.0	0.00	63.0	65.3	6.2	-	90.2	42.0	40.2	4.0	4.3	90.5
27	W	201.6	155.0	31.0	23.1	84.6	96.9	62.0	15.5	36.0	84.0	21.0	0.00	-	-	-	-	-	-	-	-	-	-
28	Th	173.2	100.0	19.2	42.3	88.9	34.6	34.6	3.8	0.0	89.0	20.6	0.10	34.2	31.1	4.7	9.1	86.3	14.2	21.8	1.7	-	88.0
29	Fr	193.3	148.6	55.7	23.1	71.2	107.8	100.3	40.9	7.0	62.1	18.9	0.00	59.3	41.5	6.8	30.0	88.5	36.5	31.5	1.4	13.7	96.2
30	Sa	140.7	117.7	41.8	16.2	70.3	60.8	49.4	11.4	18.8	81.4	9.3	0.00	40.2	40.1	4.4	-	89.1	21.8	21.9	2.2	-	90.0

Table C-1. Continued NOVEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	Total Phosphorus					Soluble Phosphorus					Total S.S.					Volatile S.S.			pH			NH_3-N	
		mg/l			% Removal		mg/l			% Removal		mg/l			% Removal		mg/l							
		Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Infl.	P.E.	S.E.	Infl.	S.E.
1	Fr	3.02	-	2.64	-	12.6	1.64	-	1.17	-	28.7	116.0	-	16.0	-	86.2	60.0	-	1.3	7.66	-	7.93	-	-
2	Sa	3.04	-	1.36	-	55.3	1.04	-	1.03	-	0.9	76.0	-	20.0	-	73.7	48.0	-	2.0	7.72	-	7.83	-	-
3	Su	2.60	-	1.80	-	30.8	1.08	-	0.97	-	10.2	152.0	-	30.6	-	79.9	108.0	-	22.6	7.78	-	7.89	-	-
4	M	1.84	-	0.84	-	54.3	0.92	-	0.63	-	31.5	120.0	-	18.0	-	85.0	96.0	-	18.0	7.86	-	7.82	-	-
5	Tu	1.72	-	1.28	-	25.6	0.86	-	0.78	-	9.3	164.0	-	49.3	-	69.9	128.0	-	38.6	-	-	-	-	-
6	W	2.20	-	0.94	-	57.3	1.26	-	0.67	-	46.8	94.0	-	36.0	-	61.7	58.0	-	20.0	7.71	-	7.86	-	-
7	Th	2.80	-	0.86	-	69.3	1.62	-	0.74	-	54.3	70.6	-	27.0	-	61.8	37.3	-	13.0	7.85	-	7.88	-	-
8	Fr	2.78	-	1.36	-	51.1	1.64	-	1.03	-	37.2	152.0	-	50.0	-	67.[illegible]	60.0	-	8.0	7.60	-	7.70	-	-
9	Sa	2.82	-	1.42	-	49.6	1.62	-	1.08	-	33.3	152.0	-	40.0	-	73.7	68.0	-	21.3	7.75	-	7.75	-	-
10	Su	2.74	-	1.64	-	40.1	1.56	-	1.09	-	30.1	52.0	-	26.0	-	48.8	46.0	-	25.3	7.92	-	7.80	19.8	18.2
11	M	4.22	-	1.76	-	58.3	2.82	-	1.37	-	51.4	88.0	-	46.6	-	47.0	50.0	-	16.0	7.82	-	7.84	23.5	25.8
12	Tu	2.64	-	0.98	-	62.9	1.26	-	0.63	-	50.0	108.0	-	30.6	-	71.7	68.0	-	17.3	7.76	-	7.70	18.6	21.2
13	W	1.52	-	0.97	-	36.2	0.60	-	0.31	-	48.3	162.0	-	41.3	-	74.5	56.0	-	25.3	7.78	-	7.80	12.1	18.0
14	Th	1.56	-	0.64	-	59.0	0.40	-	0.06	-	85.0	136.0	-	50.0	-	63.2	52.0	-	2.0	7.51	-	7.83	-	-
15	Fr	1.44	-	0.38	-	73.6	0.60	-	0.07	-	88.3	68.0	-	49.3	-	27.5	18.0	-	9.3	7.97	-	8.01	-	-
16	Sa	1.14	-	0.80	-	29.8	0.40	-	0.10	-	75.0	42.0	-	14.7	-	65.0	20.0	-	1.3	7.78	-	7.71	-	-
17	Su	0.68	-	0.33	-	51.5	0.12	-	0.05	-	58.3	26.0	-	22.0	-	15.4	12.0	-	12.0	7.80	-	7.76	3.7	5.6
18	M	1.03	-	0.33	-	68.0	0.50	-	0.03	-	94.0	32.0	-	24.0	-	25.0	26.0	-	23.0	7.90	-	7.72	4.9	5.8
19	Tu	2.09	2.05	0.59	1.9	71.8	0.85	0.97	0.03	incr	96.5	184.0	84.0	29.3	54.3	84.1	92.0	42.0	17.3	7.52	7.50	7.41	10.7	17.8
20	W	0.88	0.90	0.37	incr	58.0	0.06	0.17	0.39	incr	incr	184.0	152.0	56.0	17.4	69.6	72.0	36.0	26.0	7.58	7.65	7.32	5.7	5.2
21	Th	1.01	1.14	0.20	incr	80.2	0.55	0.90	0.03	incr	94.5	76.0	82.0	16.0	incr	78.9	38.0	36.0	8.5	-	-	-	-	-
22	Fr	1.98	1.67	0.53	15.7	73.2	0.02	1.11	0.44	incr	56.9	40.0	41.0	12.0	incr	70.0	31.0	31.0	6.5	7.30	7.35	7.35	5.7	5.0
23	Sa	1.83	1.79	0.30	2.2	83.6	-	-	-	-	-	72.0	42.0	3.5	41.7	95.1	52.0	36.0	10.0	7.65	7.55	7.60	5.3	4.8
24	Su	1.02	1.05	0.41	incr	59.8	0.51	0.47	0.19	7.8	62.7	45.0	32.0	11.5	28.9	74.4	26.0	22.0	6.0	7.85	7.61	7.61	7.9	11.9
25	M	2.01	1.63	0.38	18.9	81.1	0.86	0.98	0.06	incr	93.3	61.0	53.0	16.5	13.1	73.0	40.0	31.0	10.0	7.61	7.50	7.42	-	-
26	Tu	1.56	1.94	0.37	incr	76.3	1.48	1.24	0.12	16.2	92.0	82.0	70.0	20.5	15.0	75.0	50.0	45.0	8.5	7.68	7.60	7.61	7.3	-
27	W	1.21	0.98	0.37	19.0	69.1	0.22	0.23	0.36	incr	incr	42.0	26.0	56.0	38.1	incr	34.0	18.0	46.0	7.41	7.53	7.49	-	6.1
28	Th	1.68	1.65	0.53	1.8	68.5	0.94	0.86	0.23	8.5	76.0	48.0	20.0	12.0	58.3	75.0	38.0	12.0	8.0	7.60	7.55	7.50	-	-
29	Fr	2.50	2.08	0.79	16.8	68.4	0.97	1.20	0.23	incr	76.5	58.0	46.0	25.5	20.7	56.0	28.0	18.0	11.5	-	-	-	-	-
30	Sa	1.95	1.69	0.36	13.3	81.3	1.21	1.05	0.15	13.2	87.8	89.3	78.6	39.0	12.0	56.3	5.3	-	13.0	7.65	7.65	7.60	-	-

Table C-1. Continued NOVEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	F/M	MLSS	MLVSS	Recycle Flow	RAS	RAS Volatile	Temp.	FeCl$_3$	Aeration D.O.	Remarks
			mg/l	mg/l	gpd	mg/l	mg/l	°C	lb/day	Range	
1	Fr	0.38	656	528	10,276	2,587	2,024	18	-	2.0 - 4.4	By-passing primary clarifier
2	Sa	0.39	690	524	10,316	1,300	980	16	-	2.0 - 4.8	Cut skimmings flow by 2/3
3	Su	0.53	582	426	9,441	1,530	1,180	17	-	2.2 - 4.2	
4	M	0.34	736	530	10,587	1,540	1,135	15	-	3.4 - 6.3	Recycle plugged, influent partially plugged
5	Tu	0.21	762	578	-	1,590	1,215	14	-	2.4 - 4.8	Influent pubp down 12 mid. to 8 AM
6	W	0.52	588	444	12,089	930	760	14	-	1.6 - 5.8	Recycle channel leaking - reclined
7	Th	0.38	866	608	8,222	2,545	1,805	15	-	1.2 - 5.6	Inflow green 8 AM to 1 PM
8	Fr	0.35	916	654	-	3,685	2,725	15	-	1.6 - 5.8	Inflow green 8 AM to 1 PM
9	Sa	0.27	1,157	736	-	2,920	2,010	15	-	2.8 - 4.0	
10	Su	0.18	1,845	1,440	10,298	4,560	3,435	14	0.624	1.9 - 6.5	Start FeCl$_3$ feed at 4 PM
11	M	0.28	1,146	876	10,310	2,700	1,967	16	0.990	1.2 - 4.2	Inflow colored at various times
12	Tu	0.22	1,314	956	12,650	3,830	2,789	15	1.039	2.4 - 4.4	Rebalanced effluent weir: Inflow pink 10 - 1 PM
13	W	0.11	1,390	970	12,270	3,775	2,610	14	1.904	1.2 - 4.8	
14	Th	0.07	1,440	1,000	13,110	2,253	1,547	11	2.015	2.6 - 5.4	Heavy snow
15	Fr	0.15	520	367	12,060	223	150	8	2.717	3.8 - 7.6	Heavy snow: Unmanned 3 PM - 11 PM
16	Sa	0.17	556	325	13,450	1,577	935	10	1.855	4.8 - 8.6	
17	Su	0.12	613	331	12,640	1,278	750	10	2.178	4.0 - 7.3	
18	M	0.13	735	403	12,490	1,633	1,039	10	2.299	1.8 - 4.6	
19	Tu	0.64	890	538	13,220	3,189	1,983	12	2.415	1.8 - 3.7	Switched back to primary clarifier
20	W	0.29	1,256	680	15,150	3,315	1,806	12	2.420	2.2 - 4.6	Slight chlorine residual in Inflow
21	Th	0.31	1,497	817	14,440	5,162	2,861	10	1.901	2.4 - 6.6	
22	Fr	-	-	-	13,040	-	-	11	1.683	1.5 - 4.6	Inflow colored at various times
23	Sa	0.22	1,644	852	12,290	7,850	3,570	12	1.980	1.8 - 4.6	
24	Su	0.13	1,663	940	13,500	2,998	1,728	12	1.668	2.4 - 5.0	Inflow green at 4 AM
25	M	0.20	1,715	979	13,540	6,107	3,528	10	2.127	1.8 - 4.2	
26	Tu	0.30	1,875	1,107	12,080	4,605	2,688	12	1.966	2.0 - 5.0	Wasting and effluent lines frozen for 5 hours
27	W	-	1,898	1,102	12,320	3,974	2,439	11	1.717	2.2 - 5.4	Inflow green 8 AM - 9 PM
28	Th	0.15	1,485	966	12,510	6,146	3,893	10	1.591	1.5 - 5.0	Wasted sludge: No samples for 8 AM
29	Fr	0.20	1,453	910	8,360	4,211	2,456	10	1.647	1.2 - 5.3	Unplugged inflow pump 4 PM
30	Sa	0.14	1,125	605	10,360	1,750	[illegible]	10	0.651	3.2 - 5.0	Inflow milky 1 PM - 7 PM

Table C-2. DECEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	Total C.O.D.					Soluble C.O.D.					Flow	Precp.	Total B.O.D.					Soluble B.O.D.				
		mg/l			% Removal		mg/l			% Removal		10^3	in.	mg/l			% Removal		mg/l			% Removal	
		Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total	gpd		Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total
1	Su	173.2	165.4	43.3	4.5	75.0	82.7	78.7	35.4	4.8	57.2	17.95	0.10	61.8	52.5	5.9	15.0	90.5	30.3	16.8	1.7	44.6	94.4
2	M	246.2	199.3	66.4	19.0	73.0	113.3	109.4	39.1	3.4	65.5	22.97	0.89	71.0	61.8	10.3	13.0	85.5	43.5	41.6	7.0	4.4	83.9
3	Tu	205.4	205.4	65.9	0.0	67.9	127.9	124.0	50.4	3.0	60.6	25.51	0.00	95.3	70.2	12.3	26.3	87.1	49.1	45.5	6.2	7.3	87.4
4	W	233.5	202.4	66.9	13.3	71.3	109.0	109.0	42.8	0.0	60.7	17.44	0.00	80.3	71.3	11.8	11.2	85.3	51.5	46.9	6.6	8.9	87.2
5	Th	237.9	148.7	59.5	37.5	75.0	133.8	111.5	37.2	16.7	72.2	24.57	0.00	75.0	69.5	10.3	7.3	86.3	45.0	45.5	5.9	incr	86.9
6	Fr	248.2	229.6	55.6	7.5	77.6	118.5	103.7	29.6	12.5	75.0	21.58	0.00	90.0	72.0	11.0	20.0	87.8	49.0	49.0	5.1	0.0	89.6
7	Sa	220.6	172.8	58.8	21.7	73.3	77.2	73.5	40.4	4.8	47.7	28.76	0.10	72.0	60.0	15.0	16.7	79.2	32.4	29.5	7.2	9.0	77.8
8	Su	113.6	135.8	87.8	incr	22.8	62.3	69.6	33.0	incr	47.0	37.44	0.05	42.0	25.2	11.4	40.0	72.9	24.0	24.6	7.2	incr	70.0
9	M	170.9	181.8	65.5	incr	61.7	87.3	105.5	18.2	incr	79.2	26.95	0.05	66.0	72.0	21.2	incr	67.9	39.0	40.0	8.8	incr	77.4
10	Tu	200.0	167.3	72.3	16.4	63.9	112.7	101.8	32.7	9.7	71.0	24.68	0.00	76.5	68.0	7.5	11.1	90.2	48.0	44.0	3.6	8.3	92.5
11	W	220.6	163.6	68.5	25.8	68.9	114.1	106.5	38.0	6.7	66.7	24.46	0.08	102.0	71.0	17.4	30.4	82.9	52.0	50.0	8.8	3.8	83.1
12	Th	215.9	178.0	49.2	17.6	77.2	109.8	94.7	37.9	13.8	65.5	25.42	0.00	66.0	69.0	9.6	incr	85.5	42.0	39.0	5.6	7.1	86.7
13	Fr	156.0	243.5	57.1	incr	63.4	110.3	110.3	45.6	0.0	58.7	25.24	0.00	47.0	66.0	6.5	incr	86.2	39.0	41.0	6.6	incr	83.1
14	Sa	179.7	131.0	56.2	27.1	68.7	104.8	67.4	41.2	35.7	60.7	22.37	0.00	56.4	46.5	6.0	17.6	89.4	35.0	34.5	10.4	1.4	70.3
15	Su	241.4	139.6	45.3	42.2	81.2	98.1	79.2	37.7	19.3	61.6	23.37	0.28	60.0	55.2	6.8	8.0	88.7	35.3	34.2	7.2	2.5	79.6
16	M	197.8	164.2	44.8	17.0	77.4	108.2	89.6	33.6	17.2	68.9	25.56	0.33	75.6	67.0	8.0	11.4	89.4	49.0	40.5	5.2	17.3	89.4
17	Tu	190.9	176.0	48.7	7.8	74.5	86.1	82.4	33.7	4.3	60.9	32.32	0.24	69.6	53.0	10.8	23.9	84.5	40.5	36.0	7.6	11.1	81.2
18	W	192.6	162.1	27.0	15.8	86.0	104.2	84.7	15.4	18.7	85.2	24.76	0.03	76.5	70.8	7.6	7.5	90.1	37.5	34.0	5.7	9.3	84.8
19	Th	183.7	164.1	50.8	10.7	72.3	93.8	89.9	43.0	4.2	54.2	28.80	0.15	61.5	52.8	7.6	14.1	87.6	37.5	36.0	5.7	4.0	84.8
20	Fr	224.8	193.8	50.4	13.8	77.6	135.7	108.5	46.5	20.0	65.7	23.78	0.00	64.0	73.2	8.4	incr	86.9	38.4	39.0	8.0	incr	79.2
21																							
22																							
23																							

END OF TEST RUN

Table C-2. Continued DECEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	Total Phosphorus					Soluble Phosphorus					Total S.S.					Volatile S.S.			pH			NH_3-N	
		mg/l			% Removal		mg/l			% Removal		mg/l			% Removal		mg/l							
		Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Prim.	Total	Infl.	P.E.	S.E.	Infl.	P.E.	S.E.	Infl.	S.E.
1	Su	2.22	2.34	0.708	incr	68.1	1.38	1.30	0.316	5.8	77.1	58.0	57.0	25.5	1.7	56.0	42.0	37.0	17.5	7.98	7.73	7.70	-	-
2	M	2.27	2.34	0.922	incr	59.4	1.43	1.25	0.324	12.7	77.3	82.0	63.0	25.0	23.2	69.5	60.0	48.0	17.5	7.80	7.88	7.61	-	-
3	Tu	2.42	2.34	-	1.7	-	1.48	1.46	0.336	1.4	77.3	88.0	60.0	29.3	31.8	66.7	20.0	18.0	6.6	7.90	7.80	7.50	-	-
4	W	2.39	2.56	0.680	incr	71.5	1.70	1.48	0.256	12.9	84.9	96.0	86.0	41.3	10.4	57.0	82.0	74.0	38.6	7.86	7.72	7.54	-	-
5	Th	2.90	2.72	0.660	6.2	77.2	1.62	1.68	0.304	incr	81.2	108.0	76.0	28.0	29.6	74.1	56.0	44.0	18.6	7.82	7.79	7.68	10.8	10.0
6	Fr	2.90	2.94	0.756	incr	73.9	1.56	0.92	0.516	41.0	66.9	144.0	86.0	30.0	40.3	79.2	116.0	64.0	26.0	8.17	7.59	7.77	12.0	10.0
7	Sa	1.12	1.10	0.384	1.8	65.7	0.38	0.41	0.148	incr	61.1	204.0	176.0	42.6	13.7	79.1	92.0	72.0	16.0	7.96	7.79	7.52	9.7	10.3
8	Su	1.05	0.95	0.454	9.5	56.8	0.52	0.58	0.192	incr	63.1	60.0	50.6	20.0	15.7	66.7	42.0	34.6	17.0	7.83	7.67	7.56	4.9	6.6
9	M	2.94	3.78	0.910	incr	69.0	2.27	3.44	0.744	incr	67.2	96.0	100.0	54.6	incr	43.1	52.0	48.0	28.0	7.70	7.75	7.50	6.9	6.8
10	Tu	2.28	2.34	0.552	incr	75.8	1.52	1.48	-	2.6	-	140.0	80.0	22.0	42.9	84.3	12.0	16.0	6.0	7.92	7.89	7.82	12.8	10.6
11	W	2.39	2.27	1.240	5.0	48.1	1.62	1.38	0.544	14.8	66.4	84.8	68.6	40.0	19.1	52.8	60.0	46.0	27.0	-	-	-	13.3	14.9
12	Th	2.07	2.15	0.505	incr	75.6	1.25	1.18	0.245	5.6	80.4	80.0	80.0	13.8	-	82.8	51.0	50.0	8.7	-	-	-	7.8	8.1
13	Fr	2.08	2.13	0.413	incr	80.1	1.02	1.02	0.203	0.0	80.1	58.0	83.0	9.0	incr	84.5	24.0	45.0	3.0	7.55	7.50	7.65	6.2	5.8
14	Sa	1.82	1.84	0.280	incr	84.6	1.08	0.88	0.138	18.5	87.2	108.0	48.0	4.0	55.6	96.3	54.0	26.6	0.5	7.48	7.59	7.54	-	-
15	Su	2.58	2.06	0.390	20.2	84.9	1.04	1.27	0.190	incr	81.7	87.0	61.0	16.0	29.9	81.6	65.0	46.0	13.5	7.90	7.72	7.60	8.0	9.0
16	M	2.07	2.08	0.490	incr	76.3	1.50	1.42	0.190	5.3	87.3	73.0	52.0	14.2	28.8	80.5	62.0	45.0	10.2	7.50	7.50	7.55	7.5	7.8
17	Tu	1.55	1.52	0.330	1.9	78.7	0.81	0.72	0.165	11.1	79.6	119.0	107.0	17.3	10.1	85.5	70.0	63.0	16.0	7.70	7.65	7.40	6.8	7.5
18	W	1.85	1.88	0.260	incr	85.9	1.18	1.05	0.175	11.0	85.2	57.0	49.0	6.0	14.0	89.5	38.0	31.0	3.0	7.60	7.70	7.50	7.4	6.2
19	Th	1.85	1.76	0.275	4.9	85.1	1.17	1.02	0.125	12.8	89.3	71.0	67.0	11.3	5.6	84.1	34.0	32.0	2.0	7.50	7.40	7.35	7.3	6.6
20	Fr	2.19	2.08	0.425	5.0	80.6	1.28	1.18	0.240	7.8	81.3	79.0	67.0	21.0	15.2	73.4	67.0	52.0	19.0	7.70	7.80	7.70	10.7	9.8
21																								
22																								
23																								

END OF TEST RUN

Table C-2. Continued DECEMBER'S PLANT OPERATIONAL DATA

DATE	DAY	F/M	MLSS	MLVSS	Recycle	RAS	RAS	SVI	Temp.	FeCl3	Aeration	Remarks
					Flow		Volatile				D.O.	
			mg/l	mg/l	gpd	mg/l	mg/l		°C	lb/day	Range	
1	Su	0.52	730	423	10,380	1,378	808	-	10	1.402	2.2 - 4.2	
2	M	0.72	744	459	14,720	1,515	1,043	-	10	1.682	2.8 - 6.4	Influent colored at times
3	Tu	0.62	933	666	14,720	2,009	1,468	-	11	2.022	1.2 - 5.0	
4	W	0.40	1,070	717	11,390	2,205	1,579	-	10	1.874	2.0 - 6.0	Influent pink 10 AM - 1 PM
5	Th	0.53	1,047	739	8,000	2,780	1,874	-	11	1.565	1.8 - 4.4	$FeCl_3$ addition at two points
6	Fr	0.50	1,009	723	8,340	3,723	2,665	-	11	1.809	1.4 - 5.0	Inflow red 12 PM to 4 AM
7	Sa	0.58	1,078	691	11,180	4,775	3,216	-	12	2.384	2.4 - 5.9	
8	Su	0.31	1,100	702	12,730	4,297	2,871	-	9	3.145	1.6 - 6.2	
9	M	0.73	1,137	613	6,740	5,355	2,975	-	8	2 244	1.0 - 5.2	All lines frozen 9 PM - 6 AM
10	Tu	0.57	1,197	681	6,710	5,355	2,994	100	9	2.067	2.4 - 6.1	Primary sludge line frozen
11	W	0.52	1,190	771	6,320	5,441	3,310	97	11	2.109	1.2 - 4.8	Thawed primary sludge valve 8 AM
12	Th	0.50	1,211	806	6,920	5,057	3,368	94	11	2.265	1.4 - 4.4	
13	Fr	0.52	1,159	741	6,910	4,213	2,707	107	11	2.310	1.8 - 5.0	Started polymer addition 6 PM
14	Sa	0.46	845	527	7,000	4,320	2,855	-	11	2.197	1.7 - 7.4	
15	Su	0.52	870	579	7,040	4,023	2,743	134	10	2.300	1.8 - 5.8	
16	M	0.58	925	681	7,750	2,485	1,813	116	10	2.487	1.8 - 7.0	Influent colored at various times
17	Tu	0.72	887	549	9,730	2,938	1,806	117	9	3.031	1.2 - 8.8	Gasoline in influent· Blue color 3 - 7 AM
18	W	0.62	1,068	655	7,000	3,549	2,154	98	8	2.363	1.6 - 6.6	Influent blue 1 - 2 PM
19	Th	0.52	1,113	673	9,940	3,332	2,001	98	10	2.616	2.9 - 5.2	
20	Fr	0.61	983	661	7,680	4,176	2,769	116	9	2.234	1.4 - 5.2	Influent colored at various times
21									9		3.8	Shut down at 9 AM
22												
23												

END OF TEST RUN

Table C-3 DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
November 18										
Inflow	< 0.01	0.007	0.10	0.02	0.08	0.050	0.0011	0.04	0.65	0.033
S.E.	< 0.01	0.010	0.04	< 0.01	0.03	0.049	0.0017	0.04	0.43	0.054
% Removal	0.0	incr	60.0	50.0	62.5	2.0	incr	0.0	33.8	incr
November 19										
Inflow	< 0.01	0.20	0.21	0.07	0.02	0.500	<0.0010	0.02	0.69	0.048
S.E.	< 0.01	0.010	0.07	< 0.01	0.14	0.025	<0.0010	0.05	0.30	0.057
% Removal	0.0	50.0	66.7	85.7	incr	95.0	0.0	incr	56.5	incr
November 20										
Inflow	< 0.01	0.010	0.10	0.03	0.15	0.250	<0.0010	0.03	1.41	0.040
S.E.	< 0.01	0.040	0.07	< 0.01	0.04	0.025	<0.0010	0.03	0.65	0.070
% Removal	0.0	incr	30.0	66.7	73.3	90.0	0.0	0.0	53.9	incr
November 21										
Inflow	< 0.01	0.010	0.19	< 0.01	0.08	0.033	<0.0010	0.05	0.74	0.070
S.E.	< 0.01	0.007	0.08	< 0.01	0.04	0.02	<0.0010	0.04	0.16	0.030
% Removal	0.0	30.0	57.9	0.0	50.0	39.4	0.0	20.0	78.4	57.1
November 22										
Inflow	< 0.01	0.020	0.27	< 0.01	0.09	0.045	<0.0010	0.05	1.06	0.050
S.E.	< 0.01	0.020	0.12	< 0.01	0.06	0.024	0.0020	0.05	0.90	0.040
% Removal	0.0	0.0	55.6	0.0	33.3	46.7	incr	0.0	15.1	20.0
November 23										
Inflow	< 0.01	0.007	0.18	< 0.01	0.10	0.050	<0.0010	0.10	0.50	0.030
S.E.	< 0.01	0.010	0.04	< 0.01	0.05	0.033	0.0071	0.06	0.45	0.050
% Removal	0.0	incr	77.8	0.0	50.0	34.0	incr	40.0	10.0	incr

Table C-3 Continued DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
November 24										
Inflow	< 0.01	0.003	0.03	< 0.01	0.05	0.035	0.0250	0.01	0.16	-
S.E.	< 0.01	0.007	0.03	< 0.01	0.04	0.075	0.0250	0.03	0.18	-
% Removal	0.0	incr	0.0	0.0	20.0	incr	incr	incr	incr	-
November 25										
Inflow	< 0.01	0.020	0.30	< 0.01	0.16	0.077	<0.0010	0.09	0.45	0.0365
S.E.	< 0.01	0.010	0.11	0.01	0.05	0.024	<0.0010	0.06	0.26	0.0355
% Removal	0.0	50.0	63.3	incr	68.8	68.8	0.0	33.3	42.2	2.7
November 26										
Inflow	< 0.01	0.070	0.30	< 0.01	0.13	0.140	<0.0010	0.09	0.35	0.0475
S.E.	< 0.01	0.009	0.10	0.01	0.04	0.013	<0.0010	0.06	0.19	0.0250
% Removal	0.0	87.1	66.7	incr	69.2	90.7	0.0	33.3	45.7	47.3
November 27										
Inflow	< 0.01	0.030	0.49	< 0.01	0.14	0.077	0.0010	< 0.01	0.32	0.0530
S.E.	< 0.01	0.020	0.25	< 0.01	0.07	0.060	0.0030	0.07	0.22	0.0480
% Removal	0.0	33.3	49.0	0.0	50.0	22.1	incr	incr	31.3	9.4
November 28										
Inflow	< 0.01	0.050	0.03	< 0.01	0.26	0.042	<0.0010	< 0.01	0.11	0.0050
S.E.	< 0.01	0.020	0.06	< 0.01	0.07	0.022	<0.0010	< 0.01	0.18	0.0140
% Removal	0.0	60.0	incr	0.0	73.1	47.6	0.0	0.0	incr	incr
November 29										
Inflow	< 0.01	0.010	0.09	0.01	0.12	0.031	0.0027	0.04	0.54	0.0545
S.E.	< 0.01	0.020	0.10	0.01	0.07	0.033	0.0063	0.05	0.22	0.0480
% Removal	0.0	incr	incr	0.0	41.7	incr	incr	incr	59.3	11.9

Table C-3 Continued DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
November 30										
Inflow	-	-	-	-	-	-	-	-	-	-
S.E.	-	-	-	-	-	-	-	-	-	-
% Removal	-	-	-	-	-	-	-	-	-	-
December 1										
Inflow	<0.01	0.009	0.08	< 0.01	0.06	0.020	<0.0010	0.02	0.09	0.0630
S.E.	<0.01	0.010	0.06	< 0.01	0.04	0.021	<0.0010	0.03	0.11	0.0495
% Removal	0.0	incr	25.0	0.0	33.3	incr	0.0	incr	incr	21.4
December 2										
Inflow	<0.01	0.014	0.27	< 0.01	0.12	0.050	<0.0010	< 0.01	0.055	0.0755
S.E.	<0.01	0.012	0.08	< 0.01	0.05	0.023	<0.0010	< 0.01	0.098	0.0550
% Removal	0.0	14.3	70.4	0.0	58.3	54.0	0.0	0.0	incr	27.2
December 3										
Inflow	<0.01	0.016	0.45	< 0.01	0.17	0.100	<0.0010	0.01	0.029	0.0820
S.E.	<0.01	0.009	0.10	< 0.01	0.05	0.019	<0.0010	< 0.01	0.021	0.0790
% Removal	0.0	43.8	77.8	0.0	70.6	81.0	0.0	decr	27.6	3.7
December 4										
Inflow	<0.01	0.040	0.42	< 0.03	0.14	0.095	<0.0010	< 0.01	0.034	0.0590
S.E.	<0.01	0.012	0.12	< 0.01	0.05	0.023	<0.0010	< 0.01	0.019	0.0510
% Removal	0.0	70.0	71.4	0.0	64.3	75.8	0.0	0.0	44.1	13.6
December 5										
Inflow	<0.01	0.030	0.35	< 0.01	0.14	0.082	<0.0010	< 0.01	0.029	0.0420
S.E.	<0.01	0.009	0.10	< 0.01	0.04	0.015	<0.0010	< 0.01	0.015	0.0670
% Removal	0.0	70.0	71.4	0.0	71.4	81.7	0.0	0.0	48.3	incr

Table C-3 Continued DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
December 6										
Inflow	< 0.01	0.044	0.42	<0.01	0.30	0.115	<0.0010	0.02	0.063	0.0620
S.E.	< 0.01	0.012	0.09	<0.01	0.06	0.014	<0.0010	0.01	0.018	0.0355
% Removal	0.0	72.7	78.6	0.0	80.0	87.8	0.0	50.0	71.4	42.7
December 7										
Inflow	< 0.01	0.011	0.354	<0.01	0.14	0.154	<0.0010	<0.01	0.037	0.0665
S.E.	< 0.01	0.014	0.083	<0.01	0.07	0.018	<0.0010	<0.01	0.023	0.058
% Removal	0.0	incr	76.6	0.0	50.0	88.3	0.0	0.0	37.8	12.8
December 8										
Inflow	< 0.01	0.007	0.034	<0.01	0.08	0.131	<0.0010	<0.01	0.018	0.044
S.E.	< 0.01	0.010	0.037	<0.01	0.04	0.032	<0.0010	<0.01	0.021	0.020
% Removal	0.0	incr	incr	0.0	50.0	75.6	0.0	0.0	incr	54.5
December 9										
Inflow	< 0.01	0.006	0.12	<0.01	0.16	0.08	<0.0020	0.12	0.46	0.0040
S.E.	< 0.01	0.007	0.15	<0.01	0.03	0.04	<0.0020	0.10	0.20	0.0051
% Removal	0.0	incr	incr	0.0	81.3	50.0	0.0	16.7	56.5	incr
December 10										
Inflow	< 0.01	0.010	0.18	<0.01	0.22	0.10	<0.0020	0.08	0.25	0.0950
S.E.	< 0.01	0.007	0.06	<0.01	0.02	0.01	<0.0020	0.10	0.13	0.035
% Removal	0.0	30.0	66.7	0.0	90.9	90.0	0.0	incr	48.0	63.2
December 11										
Inflow	< 0.01	0.013	0.19	<0.01	0.10	0.08	<0.0020	0.09	0.30	0.0620
S.E.	< 0.01	0.011	0.12	<0.01	0.16	0.04	<0.0020	0.08	0.18	0.1880
% Removal	0.0	15.4	36.8	0.0	incr	50.0	0.0	11.1	40.0	incr

Table C-3 Continued DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
December 12										
Inflow	< 0.01	0.011	0.14	<0.01	0.14	0.11	<0.0020	0.17	0.27	0.0490
S.E.	< 0.01	0.008	0.06	<0.01	0.03	0.01	<0.0020	0.13	0.15	0.0500
% Removal	0.0	27.3	57.1	0.0	78.6	90.9	0.0	23.5	44.4	incr
December 13										
Inflow	< 0.01	0.013	0.19	<0.01	0.09	0.11	<0.0020	0.09	0.34	0.0370
S.E.	< 0.01	0.007	0.08	<0.01	0.02	0.01	<0.0020	0.08	0.15	0.0270
% Removal	0.0	46.2	57.9	0.0	77.8	90.9	0.0	11.1	55.9	27.0
December 14										
Inflow	< 0.01	0.009	0.09	<0.01	0.05	0.05	<0.0020	0.04	0.22	0.0425
S.E.	< 0.01	0.005	0.05	<0.01	0.01	0.02	<0.0020	0.08	0.16	0.0405
% Removal	0.0	44.4	44.4	0.0	80.0	60.0	0.0	incr	27.3	4.7
December 15										
Inflow	< 0.01	0.007	0.03	<0.01	0.08	0.05	<0.0020	0.05	0.17	0.0390
S.E.	< 0.01	0.006	0.02	<0.01	0.01	0.02	<0.0020	0.03	0.13	0.0220
% Removal	0.0	14.3	33.3	0.0	87.5	60.0	0.0	40.0	23.5	43.6
December 16										
Inflow	< 0.01	0.014	0.20	<0.01	0.15	0.11	<0.0020	0.07	0.31	0.0425
S.E.	< 0.01	0.007	0.06	<0.01	0.06	0.02	<0.0020	0.04	0.16	0.0345
% Removal	0.0	50.0	70.0	0.0	60.0	81.8	0.0	42.9	48.4	18.8
December 17										
Inflow	< 0.01	0.011	0.13	<0.01	0.13	0.15	<0.0020	0.09	0.33	0.0390
S.E.	< 0.01	0.008	0.06	<0.01	0.06	0.03	<0.0020	0.10	0.16	0.0210
% Removal	0.0	27.3	53.8	0.0	53.8	80.0	0.0	incr	51.5	46.2

Table C-3 Continued DAILY TRACE ELEMENT CONCENTRATIONS

Day	Concentration - mg/l									
	As	Cd	Cr-T	Cr-hex	Cu	Pb	Hg	Ni	Zn	CN
December 18										
Inflow	< 0.01	0.013	0.13	<0.01	0.10	0.08	<0.0020	0.05	0.21	0.0480
S.E.	< 0.01	0.01	0.04	<0.01	0.06	0.02	<0.0020	0.05	0.15	0.0280
% Removal	0.0	23.1	69.2	0.0	40.0	75.0	0.0	0.0	28.6	41.7
December 19										
Inflow	< 0.01	0.012	0.30	<0.01	0.34	0.08	<0.0020	0.11	0.28	0.0360
S.E.	< 0.01	0.006	0.02	<0.01	0.06	0.02	<0.0020	0.05	0.14	0.0320
% Removal	0.0	50.0	93.3	0.0	82.4	75.0	0.0	54.5	50.0	11.1
December 20										
Inflow	< 0.01	0.042	0.29	<0.01	0.30	0.08	<0.0020	0.06	0.32	0.1310
S.E.	< 0.01	0.014	0.06	<0.01	0.09	0.02	<0.0020	0.06	0.16	0.1130
% Removal	0.0	66.7	79.3	0.0	70.0	75.0	0.0	0.0	50.0	13.7

Table C-4 WASTE PRIMARY SLUDGE CHARACTERISTICS

Parameter	Concentration - mg/1				
	11/18 - 11/24	11/25 - 12/1	12/2 - 12/8	12/9 - 12/15	12/16 - 12/20
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	0.090	0.320	0.670	0.718	0.454
Chromium-T	7.60	5.60	12.90	10.00	6.00
Chromium-hex	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	0.02	2.32	8.54	8.10	6.26
Cyanide	2.10	2.50	1.64	1.49	1.18
Lead	1.70	3.10	12.00	15.00	9.00
Mercury	0.010	0.010	0.080	0.025	<0.002
Nickel	14.50	0.31	1.29	1.60	1.50
Zinc	19.00	5.72	2.10	26.50	18.30
T.S.S.	13,951	13,899	14,496	16,897	8,572
T.V.S.S.	8,829	8,512	9,885	10,809	5,814
Phosphorus-T	-	242.1	186.5	236.2	122.2
Discharge-gal.	42.3	48.8	55.4	61.8	69.8

Table C-5 WASTE SECONDARY SLUDGE CHARACTERISTICS

Parameter	Concentration - mg/l				
	11/18 - 11/24	11/25 - 12/1	12/2 - 12/8	12/9 - 12/15	12/16 - 12/20
Arsenic	------------ NONE WASTED ------------	<0.01	<0.01	<0.01	<0.01
Cadmium		0.750	0.357	0.274	0.192
Chromium-T		18.80	9.55	7.00	4.00
Chromium-hex		<0.01	<0.03	<0.01	<0.01
Copper		12.00	3.58	4.33	3.81
Cyanide		4.00	2.53	2.09	1.06
Lead		9.50	5.60	8.00	6.00
Mercury		0.027	0.025	2.5	<0.002
Nickel		1.50	0.70	1.00	1.30
Zinc		14.00	1.60	11.40	6.74
T.S.S.		3,835	4,027	4,833	3,284
T.V.S.S.		2,318	2,742	2,997	2,099
Phosphorus-T		78.8	84.5	132.9	73.7
Discharge-gal.		980.0	537.5	685.5	796.7

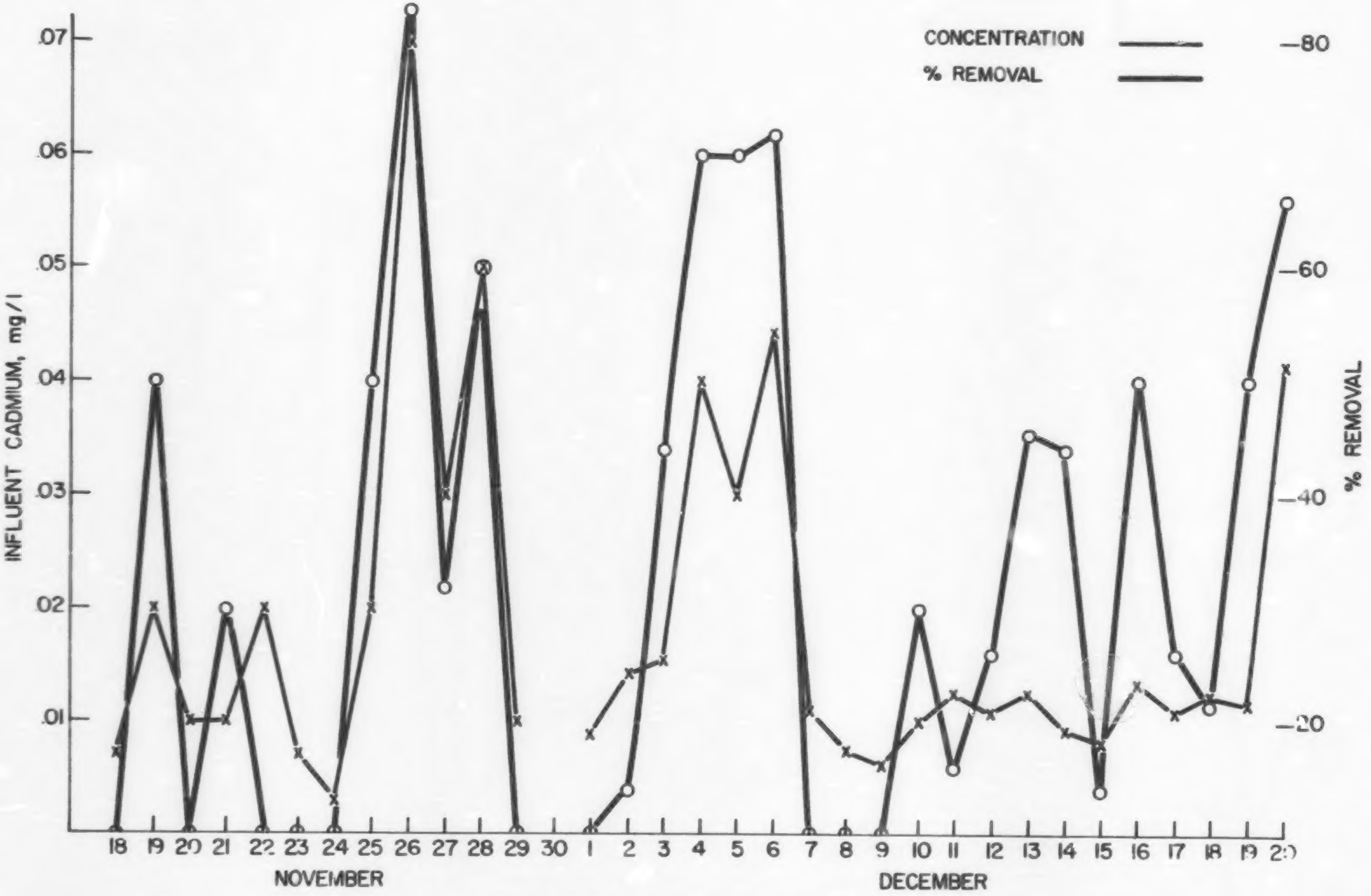

Figure C-1 Daily Cadmium Variation

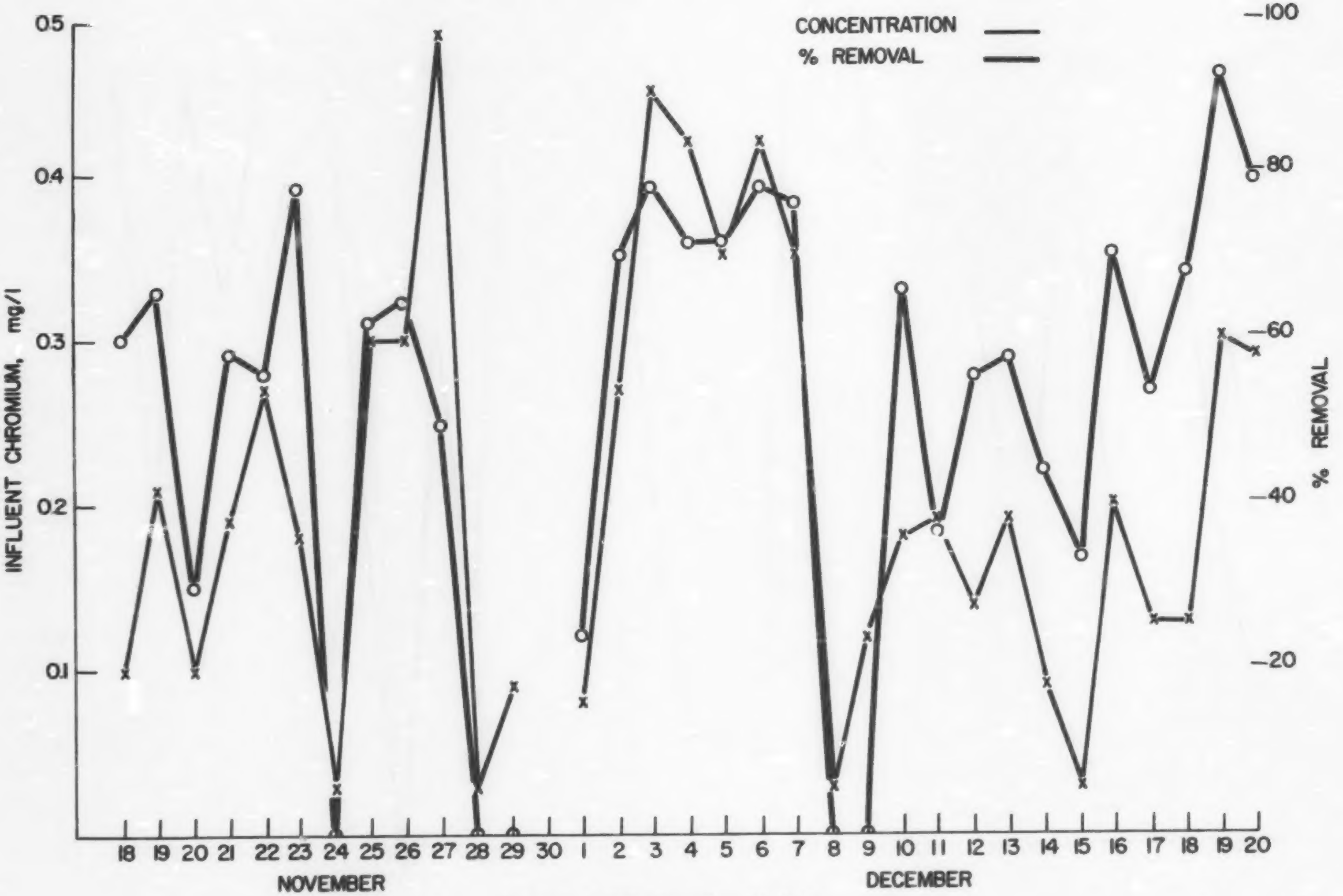

Figure C-2 Daily Chromium Variation

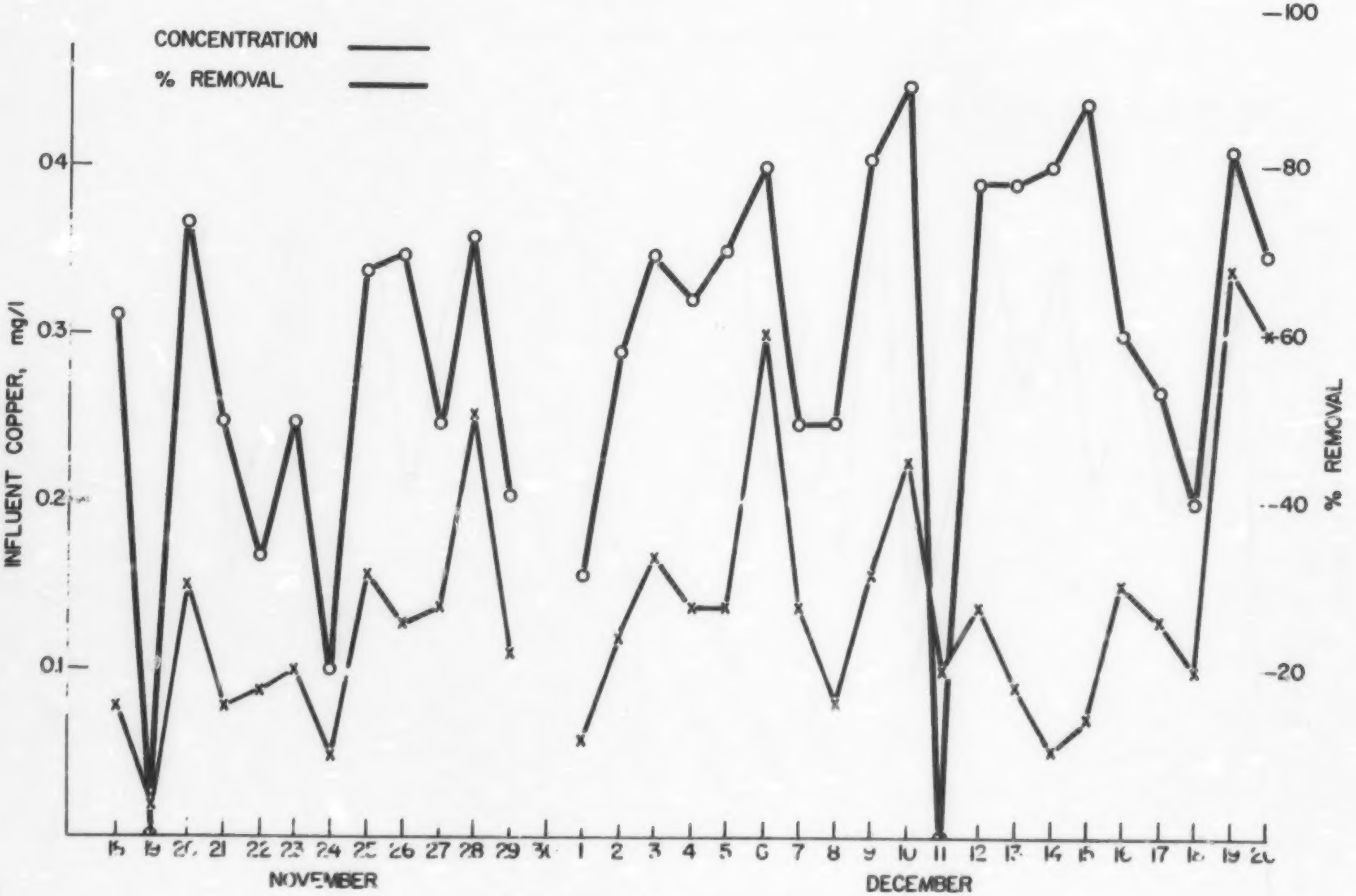

Figure C-3 Daily Copper Variation

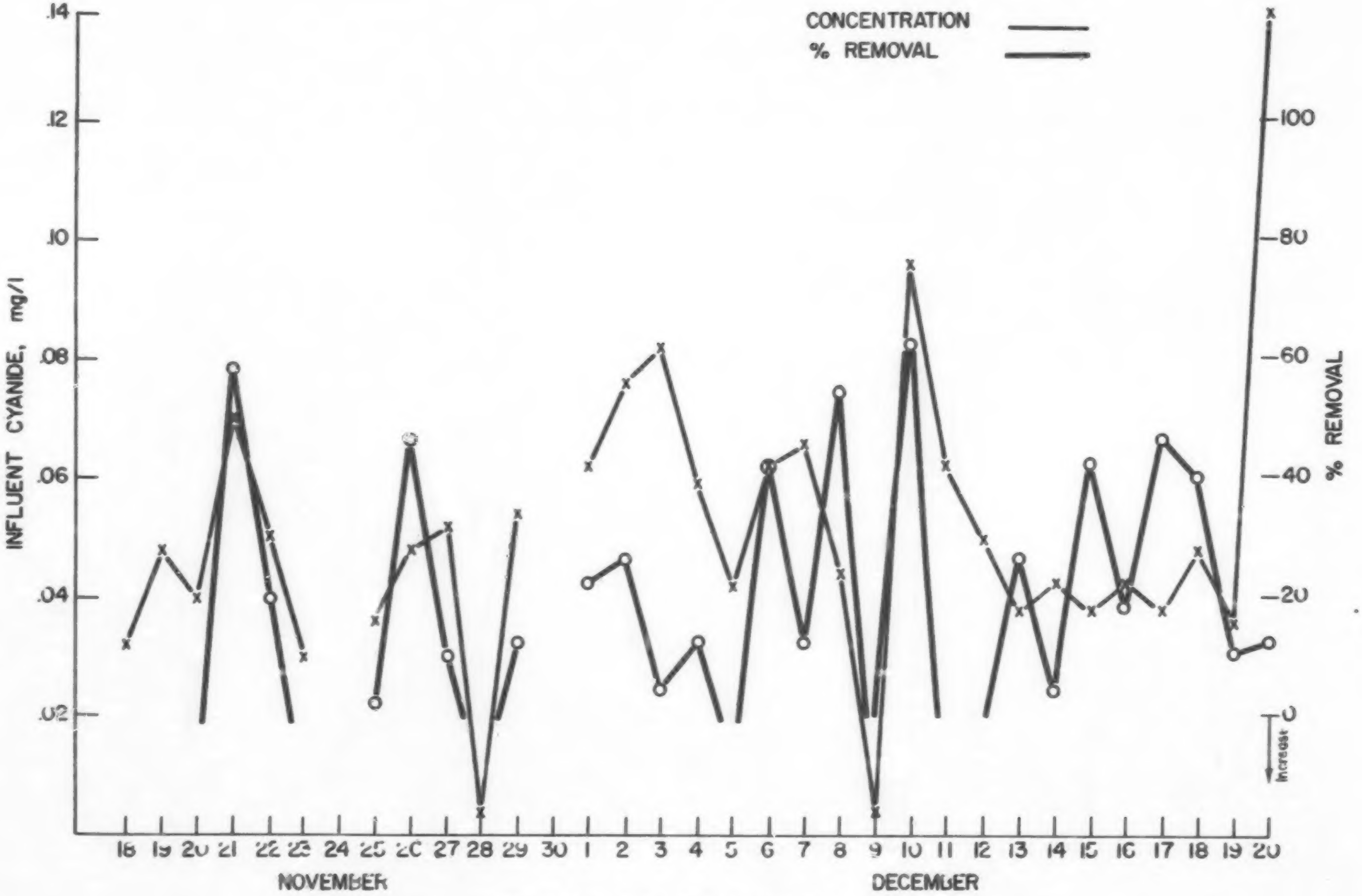

Figure C-4 Daily Cyanide Variation

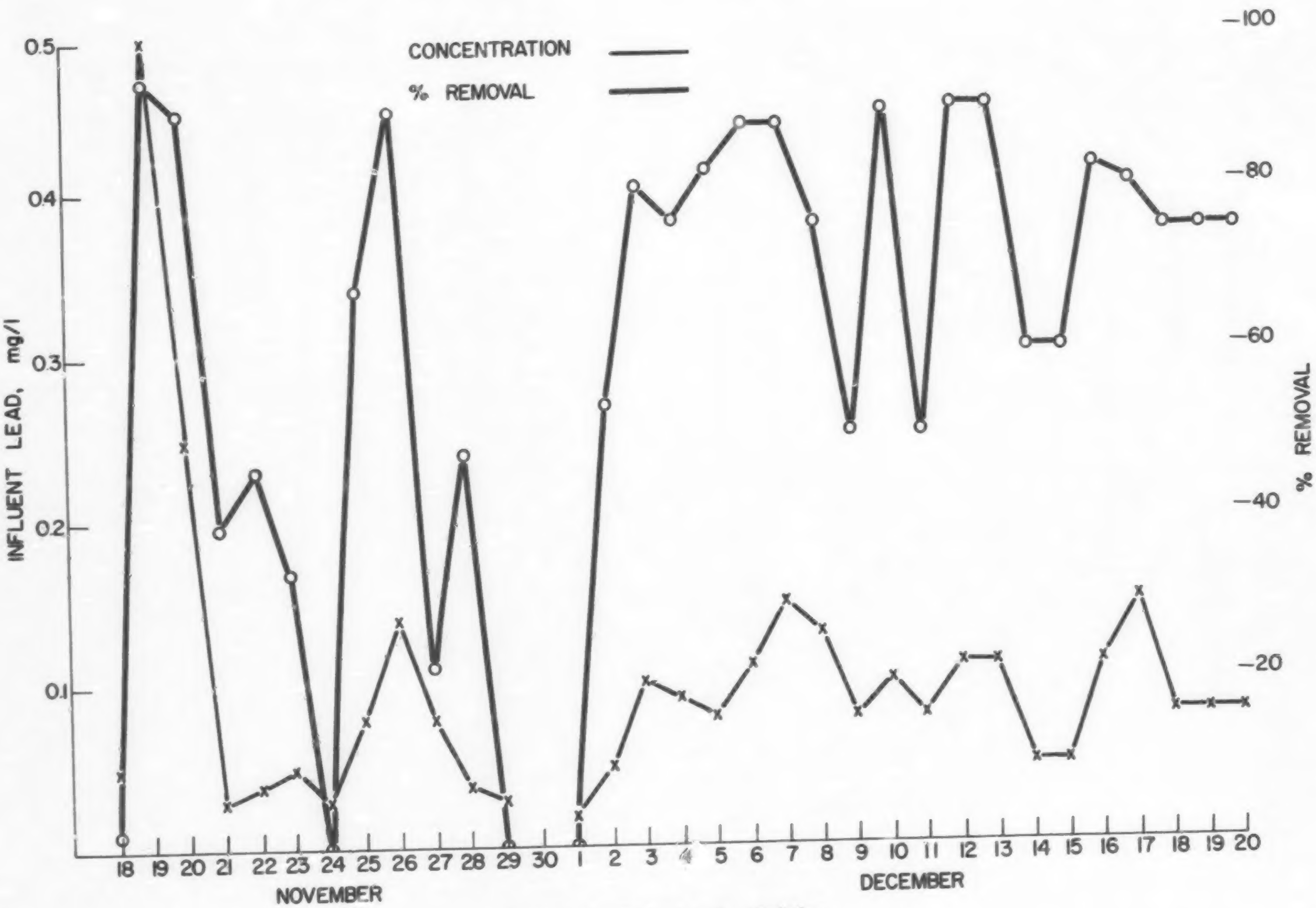

Figure C-5 Daily Lead Variation

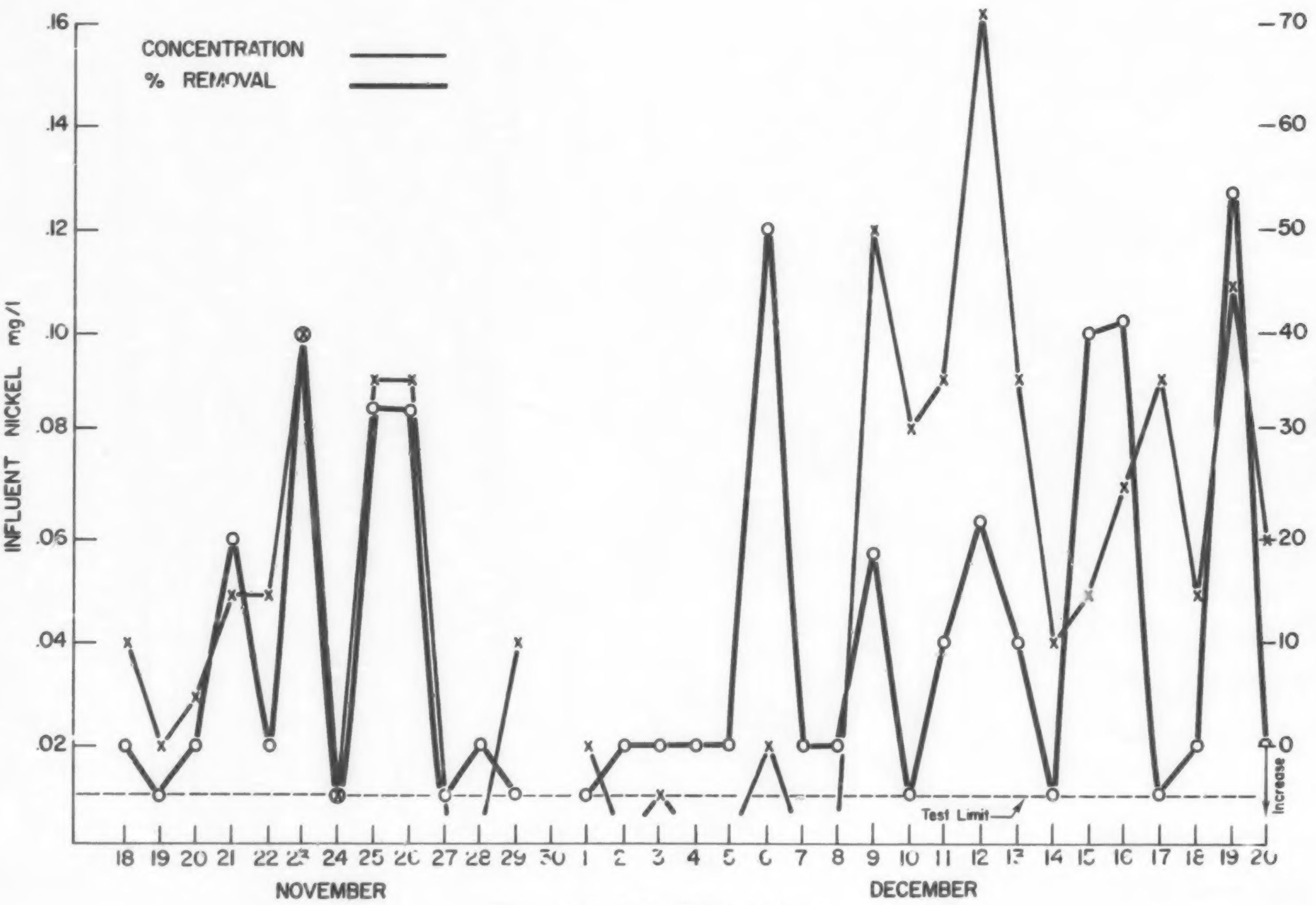

Figure C-6 Daily Nickel Variation

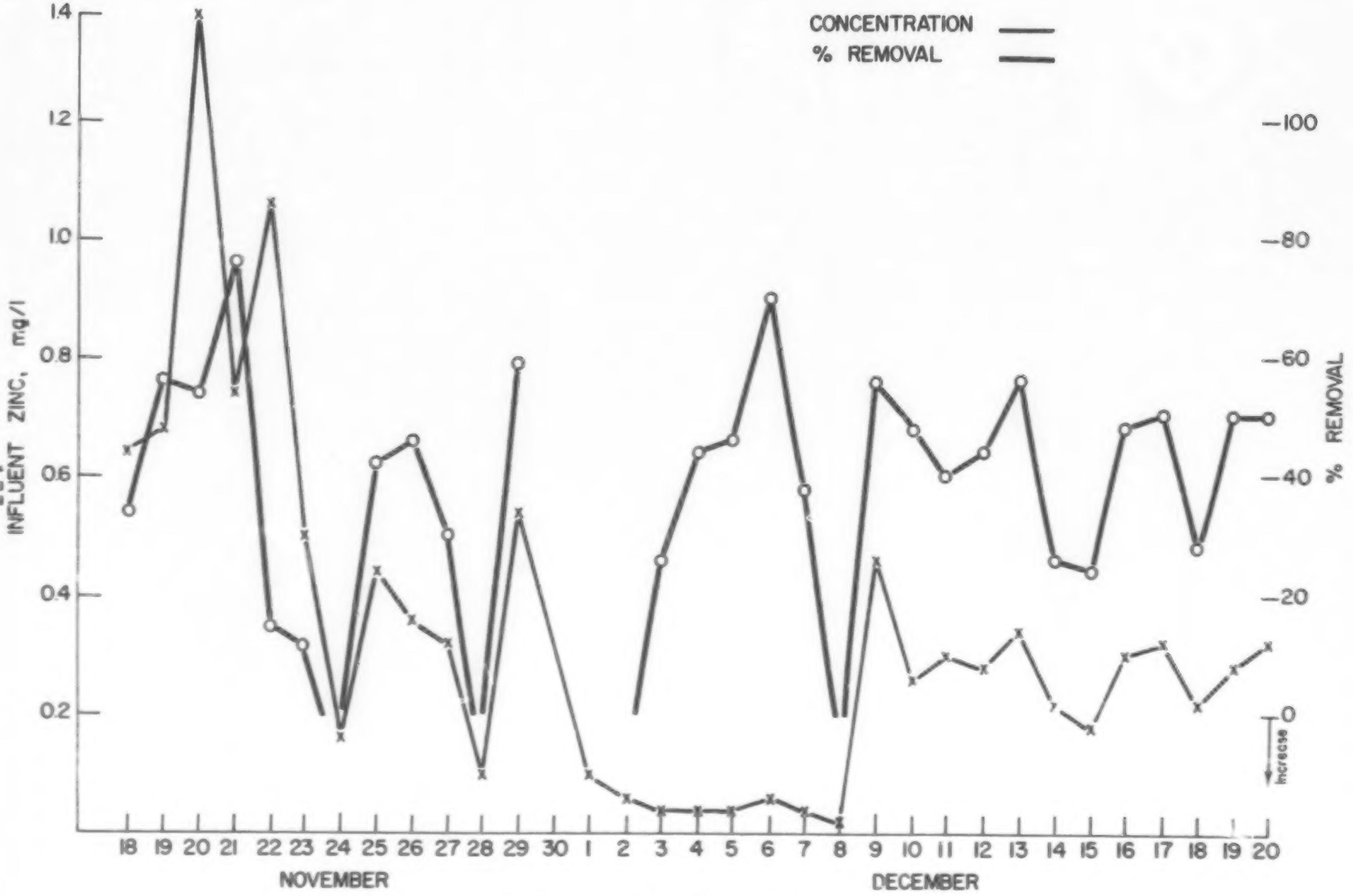

Figure C-7 Daily Zinc Variation